Cleanliness and Care of Outboard Motor

A marine power product is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the ten thousands of an inch./mm When any product component is serviced, care and cleanliness are important. Throughout this manual, it should be understood that proper cleaning, and protection of machined surfaces and friction areas is a part of the repair procedure. This is considered standard shop practice even if not specifically stated.

Whenever components are removed for service, they should be retained in order. At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.

Before raising or removing and outboard engine from a boat, the following precautions should be adhered to:

(1) Check that flywheel is secured to end of crankshaft with a locknut and lifting eye is threaded into flywheel a minimum of 5 turns.

(2) Connect a hoist of suitable strength to the lifting eye.

In addition, personnel should not work on or under an outboard which is suspended. Outboards should be attached to work stands, or lowered to ground as soon as possible.

We reserve the right to make changes to this manual without prior notification.

Refer to dealer service bulletins for other pertinent information concerning the products described in this manual.

Service Manual Outline

Section 1 - General Information & Specifications

Section 2 - Electrical & Ignition

- Part A - Ignition System
- Part B - Battery, Charging System & Starting System
- Part C - Timing/Synchronizing & Adjusting
- Part D - Wiring Diagrams

Section 3 - Fuel Systems

- Part A - Carburetion
- Part B - Fuel Pump
- Part C - Fuel Enrichment
- Part D - Oil Injection

Section 4 - Powerhead

Section 5 - Mid-Section

- Part A - Clamp/Swivel Brackets and Driveshaft Housing
- Part B - Power Trim (Design I)
- Part C - Power Trim (Design II)
- Part D - Power Trim (Design III)
- Part E - Power Trim (Design IV)
- Part F - Manual Tilt (Design I, II, III)
- Part G - Manual Tilt (Design IV)

Section 6 - Lower Unit

- Part A - Standard Gear Housing
- Part B - 60 Big Foot, 60 SeaPro & Marathon Gear Housing
- Part C - Jet Drive

Section 7 - Outboard Installation/ Attachments

- Part A - Ride-Guide Steering - Throttle/Shift Cables & Electrical Connections
- Part B - Tiller Handle and Co-Pilot
- Part C - Rewind Starter

Notice

Throughout this publication, “Dangers”, “Warnings” and “Cautions” (accompanied by the International HAZARD Symbol ⚠) are used to alert the mechanic to special instructions concerning a particular service or operation that may be hazardous if performed incorrectly or carelessly. **OBSERVE THEM CAREFULLY!**

These “Safety Alerts” alone cannot eliminate the hazards that they signal. Strict compliance to these special instructions when performing the service, plus “Common Sense” operation, are major accident prevention measures.

⚠ DANGER

DANGER - Immediate hazards which WILL result in severe personal injury or death.

⚠ WARNING

WARNING - Hazards or unsafe practices which COULD result in severe personal injury or death.

⚠ CAUTION

Hazards or unsafe practices which could result in minor personal injury or product or property damage.

Notice to Users of This Manual

This service manual has been written and published by the Service Department of Mercury Marine to aid our dealers’ mechanics and company service personnel when servicing the products described herein.

It is assumed that these personnel are familiar with the servicing procedures of these products, or like or similar products manufactured and marketed by Mercury Marine, that they have been trained in the recommended servicing procedures of these products which includes the use of mechanics’ common hand tools and the special Mercury Marine or recommended tools from other suppliers.

We could not possibly know of and advise the service trade of all conceivable procedures by which a service might be performed and of the possible hazards and/or results of each method. We have not undertaken any such wide evaluation. Therefore, anyone who uses a service procedure and/or tool, which is not recommended by the manufacturer, first must completely satisfy himself that neither his nor the products safety will be endangered by the service procedure selected.

All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of publication. As required, revisions to this manual will be sent to all dealers contracted by us to sell and/or service these products.

It should be kept in mind, while working on the product, that the electrical system and ignition system are capable of violent and damaging short circuits or severe electrical shocks. When performing any work where electrical terminals could possibly be grounded or touched by the mechanic, the battery cables should be disconnected at the battery.

Any time the intake or exhaust openings are exposed during service they should be covered to protect against accidental entrance of foreign material which could enter the cylinders and cause extensive internal damage when the engine is started.

It is important to note, during any maintenance procedure replacement fasteners must have the same measurements and strength as those removed. Numbers on the heads of the metric bolts and on the surfaces of metric nuts indicate their strength. American bolts use radial lines for this purpose, while most American nuts do not have strength markings. Mismatched or incorrect fasteners can result in damage or malfunction, or possibly personal injury. Therefore, fasteners removed should be saved for reuse in the same locations whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original.

GENERAL INFORMATION and SPECIFICATIONS

1

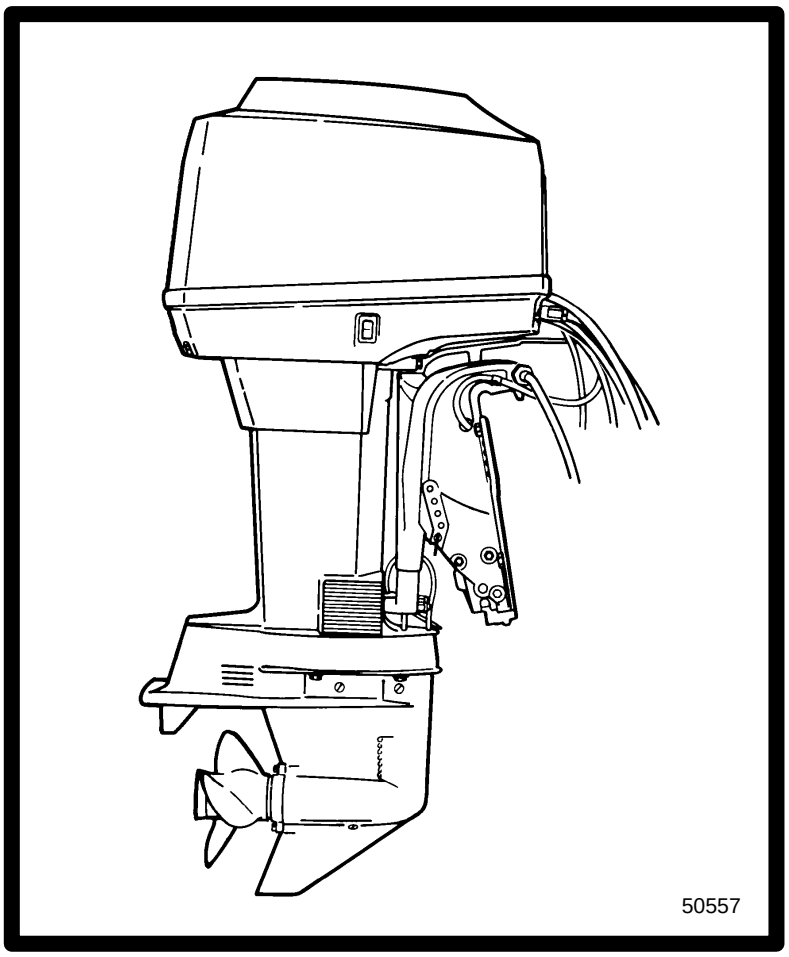


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Propeller Information

For in-depth information on marine propellers and boat performance – written by marine engineers – see your Authorized Dealer for the illustrated “What You Should Know About Quicksilver Propellers... and Boat Performance Information” (Part No. 90-86144).

How To Use This Manual

The manual is divided into SECTIONS (shown, right) which represents major components and systems.

Some SECTIONS are further divided into PARTS. Each PART has a title page. A “Table of Contents” for the particular PART is printed on the back of the title page.

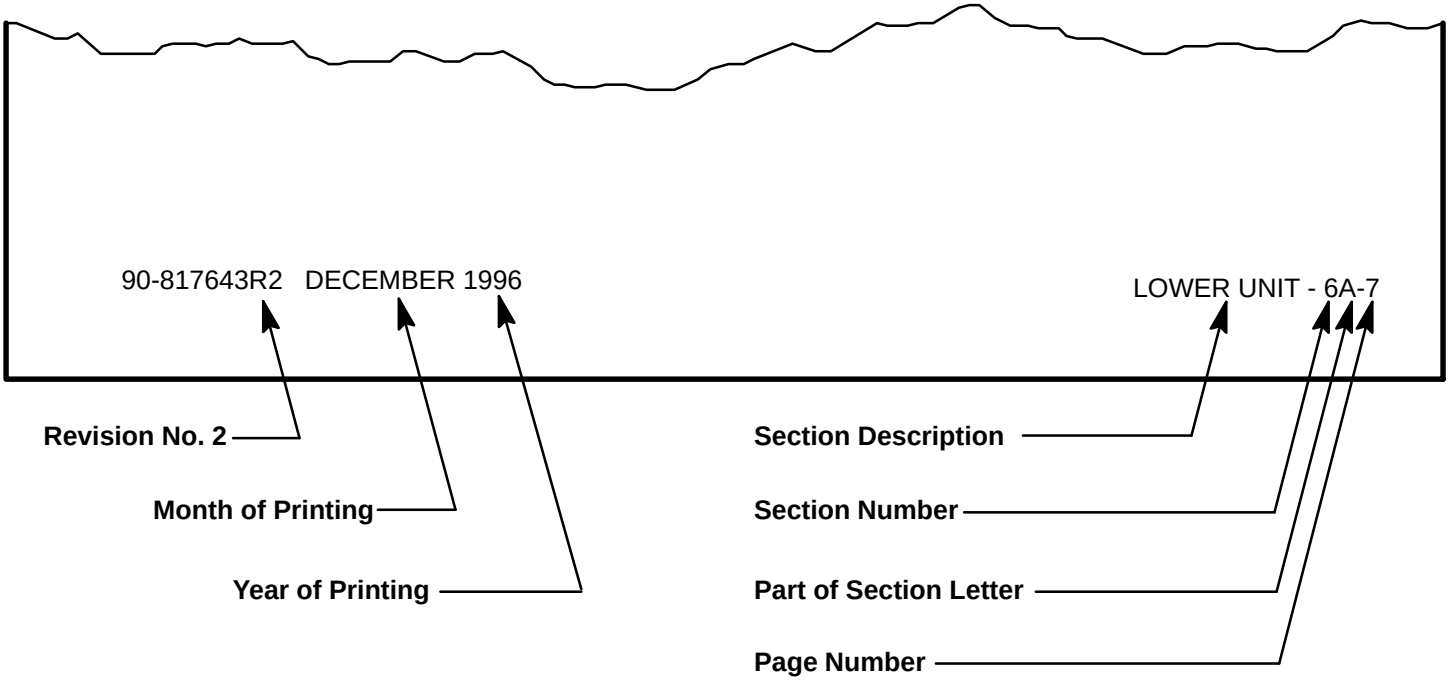
SECTIONS and PARTS are listed on the “Service Manual Outline” sheet which immediately follows the cover of this book.

Section	Section Heading
1	General Information and Specifications
2	Electrical & Ignition
3	Fuel Systems
4	Powerhead
5	Mid-Section
6	Lower Unit
7	Outboard Installation/Attachments

Page Numbering

Two number groups appear at the bottom of each page. The example, below, is self-explanatory.

EXAMPLE:



Master Specifications

Model 45 Jet/50/55 Marathon-Seapro/60/60 Marathon-Seapro/60 Bigfoot		
HORSEPOWER (KW)	**Model 50** **Model 55** **Model 60** **Model 45 Jet**	50 (37) 55 (41) 60 (45) 60 (45)
OUTBOARD WEIGHT	**Electric Start (ELPTO)** **(ELO)** **Manual Start (ML)**	217.0 lbs. (98.4kg) 213.0 lbs. (96.6kg) 213.0 lbs. (96.6kg)
CYLINDER BLOCK	**Type** **Displacement**	Two-Stoke Cycle – Loop Charged 51.8 cu. in. (849cc)
STROKE	**Length**	2.520 in. (64.008mm)
CYLINDER BORE	**Diameter (Std)** **Taper/Out of Round Maximum** **Bore Type**	2.955 in. (75.057mm) 0.003 in. (0.076mm) Cast Iron
PISTON	**Piston Type** **Standard** **0.015 in. (0.381mm) Oversize** **0.030 in. (0.762) Oversize**	Aluminum 2.950 in. (74.93 mm) 2.965 in. (75.31 mm) 2.980 in. (75.69 mm)
REEDS	**Reed Stand 0pen (Max.)** **Reed Stop (Max.)** **Reed Thickness** **– 45 Jet/50/60** **– 55**	0.020 in. (0.50mm) Not Adjustable 0.008 in. (0.203mm) 0.010 in. (0.254mm)
GEAR HOUSING	**50/55/60** **Gear Ratio** **Gearcase Capacity** **Forward Gear - No. of Teeth** **Pinion Gear - No. of Teeth** **Pinion Height** **Forward Gear Backlash** **Water Pressure** **– @ Idle** **– @ WOT** **60 SeaPro/Marathon, 60 Bigfoot** **Gear Ratio** **Gearcase Capacity** **Forward Gear - No. of Teeth-Type** **Pinion Gear - No. of Teeth-Type** **Pinion Height** **Forward Gear Backlash** **Water Pressure @ RPM**	 1.64:1 11.5 fl. oz. (340ml) 23 14 0.025 in. (0.64mm) 0.013 in. – 0.019 in. (0.33mm – 0.48mm) 1 – 3 PSI 7 – 12 PSI 2.3:1 22.5 fl. oz. (655ml) 30 13 0.025 in. (0.64mm) 0.012 in. to 0.019 in. (0.30mm to 0.48mm) 10 to 15 PSI (69 to 103 kPa) @ 5250 RPM
FUEL SYSTEM	**Fuel** **Recommended Gasoline** **Recommended Oil** **Gasoline/Oil Ratio** **Fuel Pressure – @ Idle** **– @ WOT**	Pre-Mixed Gasoline and Oil Unleaded 87 Octane Minimum Quicksilver TC-W II or TC-W3 2 Cycle Outboard Oil 50:1 (25:1 Break-In) 3-1/2 PSI 6 PSI

Model 45 Jet/50/55 Marathon-Seapro/60/60 Marathon-Seapro/60 Bigfoot		
STARTING SYSTEM	**Manual Start – All Models** **Electric Start – Optional – All Models** **Starter Draw (Under Load)** **Battery Rating**	Recoil Starter 125 Amperes Min. Reserve Cap. Rating of 100 Min. and CCA of 350 Amperes
IGNITION SYSTEM	**Type** **Spark Plug Type** **Spark Plug Gap**	Capacitor Discharge NGK BP8H-N-10 0.040 in. (1.0mm)
CHARGING SYSTEM	**Alternator Output** **Electric Models** **Manual Models (Not Regulated)**	 16 Amperes @ 3000 RPM 14 Amperes @ 300 RPM 9 Amperes @ 3000 RPM
C A R B U R E T O R	**Idle RPM** **Wide Open Throttle (WOT) RPM** **Idle Mixture Screw Adjustment (Preset - Turns Out)** **Model 50** **All Other Models** **Float Adjustment** **Float Level** **Main Jet** **– Model 50 (WME – 43)** **– Model 55/60 Seapro-Marathon (WME – 44)** **– Model 45 Jet/60 (WME – 45)** **Vent Jet** **– Model 50 (WME – 43)** **– Model 55/60 Seapro-Marathon (WME – 44)** **– Model 45 Jet/60 (WME – 45)**	675 ± 25 5000 – 5500 1-1/8 ± 1/4 1-1/2 ± 1/4 7/16 in. (11.2mm) .048 in. .060 in. .062 in. .090 in. None .090 in.
OIL INJECTION	**Recommended Oil** **Oil Tank Capacity/Approx. Time** **Reserve Capacity/Approx. Time** **Output @ 1500 RPM for 10 Minutes with Pump @ Full Open**	Quicksilver TC-W II or TC-W 3 3.0 qts. (2.8L) 7 hrs. 14.5 fl. oz. (0.43L) 1/2 hr. 10.0cc ± 3cc
T I M I N G	**Idle** **Maximum BTDC** **@ Cranking Speed** **– Model 50/60** **– Model 55/60 Seapro-Marathon** **@ 5000 RPM** **– Model 50/60** **– Model 55/60 Seapro-Marathon**	2° – 6° ATDC 24° BTDC 18° BTDC 22° BTDC 16° BTDC

Powerhead

Specifications

Block

Type	3 Cylinder, 2 Cycle
Displacement	
50/55/60 Horsepower	51.8 cu in. (849 cc)

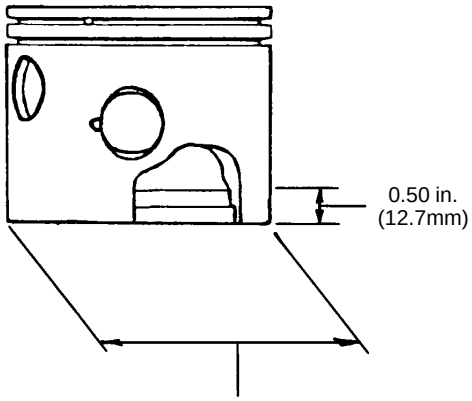
Cylinder Bore

Dia. Standard	2.955 in. (75.057 mm)
Dia. .015 in. Oversize	2.970 in. (75.438 mm)
Dia. .030 in. Oversize	2.985 in. (75.819 mm)
Out of Round (Max.)	0.003 in. (0.076 mm)
Taper (Max.)	0.003 in. (0.076 mm)

Piston

Dia. Standard	2.950 in. (74.93 mm)
Dia. .015 in. Oversize	2.965 in. (75.31 mm)
Dia. .030 in. Oversize	2.980 in. (75.69 mm)

IMPORTANT: Measure piston skirt at right angle (90°) to piston pin center line, 0.50 in. (12.7mm) up from bottom edge of skirt.



PISTON SIZE	PISTON SKIRT DIAMETER	CYLINDER BORE FINISH HONE
Standard Piston	2.950 in. (74.93 mm)	2.955 in. (75.057mm)
0.015 in. (0.381 mm) Oversize	2.965 in. (75.31 mm)	2.970 in. (75.438 mm)
0.030 in. (0.752 mm) Oversize	2.980 in. (75.69 mm)	2.985 in. (75.819 mm)

Reed Block

Reed Stop Opening (Max.)	0.020 in. (0.50 mm)

Crankshaft

Runout (Max.)	0.003 in. (0.08 mm)
Taper (Max.)	0.003 in. (0.08 mm)

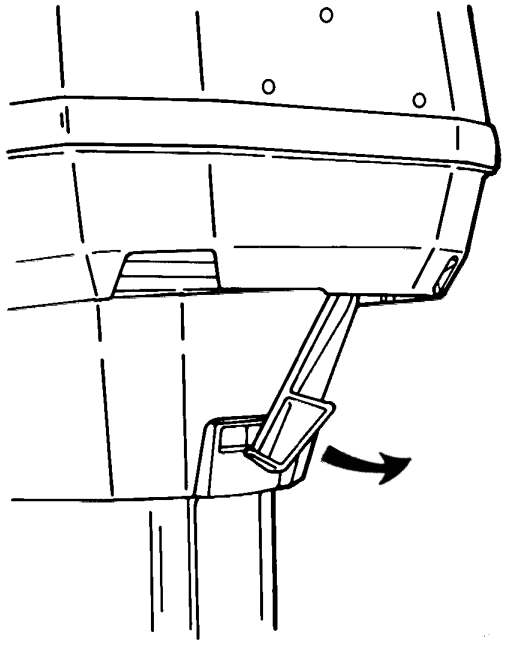
Firing Order 1-3-2

Special Tools

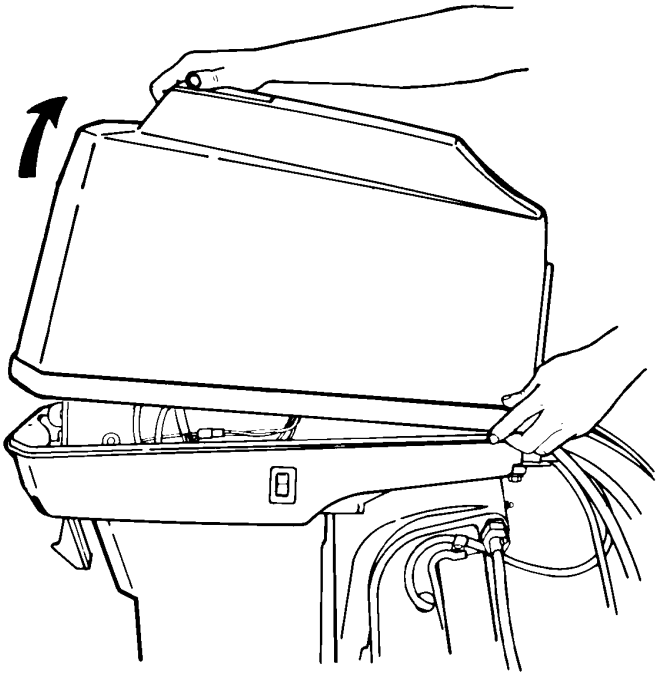
Description	Part Number
Flywheel Holder	91–52344
Protector Cap	91-24161
Flywheel Puller	91-73687A1
Lifting Eye	91-90455
Piston Ring Expander	91-24697
Piston Pin Tool	91-74607A2
Lock Ring Installation Tool	91-77109A1
Powerhead Stand	91-25821A1
*Torque Wrench (0–200 lb. ft.)	91-32610
*Torque Wrench (0–150 lb. in.)	91-66274
Compression Tester	91-29287

*May be Obtained Locally

Cowl Removal



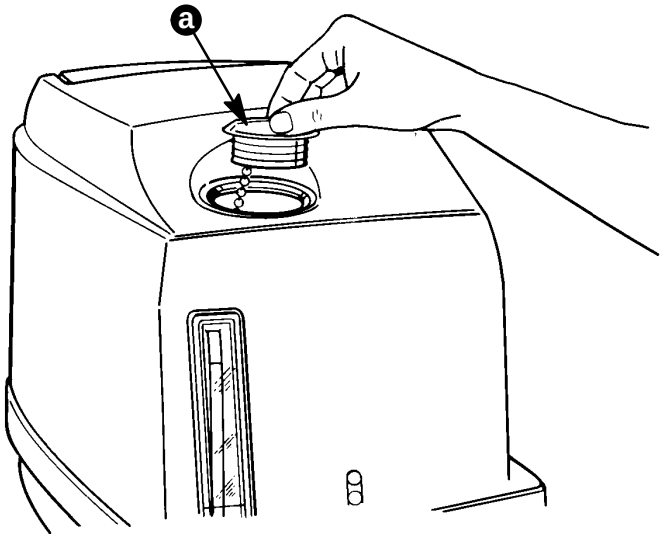
50553



50554

Filling Oil Injection System

Remove fill cap (a) from the oil tank and fill tank with oil. Retighten the fill cap.



50552

Use Quicksilver NMMA Certified TC-W3 or TC-WII 2-Cycle Outboard Oil.

- Quicksilver Certified TC-W3 Outboard Oil is a higher grade oil that provides increased lubrication and extra resistance to carbon buildup when used with good or varying grades of gasoline.
- Quicksilver Certified TC-WII Outboard Oil is an industry leading oil that provides superior outboard lubrication and resistance to carbon buildup when used with good grades of gasoline.

Periodically consult with your dealer to get the latest gasoline and oil recommendations. If Quicksilver 2-Cycle Outboard Oil is not available, substitute a 2-Cycle outboard manufacturers oil that is NMMA Certified TC-W3 or TC-WII, or another brand of 2-Cycle outboard oil that is NMMA Certified TC-W3 or TC-WII. The use of an inferior 2-Cycle outboard oil can reduce engine durability. Damage from use of inferior oil may not be covered under the limited warranty.

Propeller Selection

1. Select a propeller that will allow the engine to operate at or near the top of the recommended full throttle RPM range (listed in “Specifications,” preceding) with a normal load. Maximum engine speed (RPM) for propeller selection exists when boat speed is maximum and trim is minimum for that speed. (High RPM, caused by an excessive trim angle, should not be used in determining correct propeller.) Normally, there is a 150-350 RPM change between propeller pitches.
2. If full throttle operation is below the recommended range, the propeller MUST BE changed to one with a lower pitch to prevent loss of performance and possible engine damage.
3. For better acceleration, such as is needed in water skiing, changing to a different pitch to increase the engine speed to 500 RPM above the recommended range is advised. Continuous operation above the recommended maximum RPM, however, is not permissible.
4. After initial propeller installation, the following common conditions may require that the propeller be changed to a lower pitch:
   a. Warmer weather and great humidity will cause an RPM loss.
   b. Operating in a higher elevation causes an RPM loss.
   c. Operating with a damaged propeller or a dirty boat bottom or gear housing will cause an RPM loss.
   d. Operation with an increased load (additional passengers, equipment, pulling skiers, etc.).

Propeller Installation

⚠ WARNING

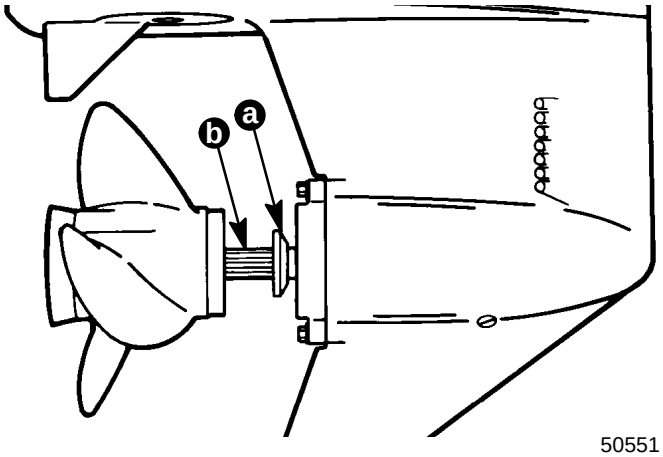
To avoid accidental starting, which could result in personal injury, remove spark plug leads from spark plugs before working near propeller. Place a block of wood between the anti-ventilation plate and propeller to protect hands from propeller blades while tightening propeller nut.

⚠ CAUTION

If the propeller moves forward-and-aft on the propeller shaft (is loose), retighten the propeller nut. Operation with a loose propeller could cause damage to the thrust hub and gear housing during acceleration, deceleration or when shifting gears.

IMPORTANT: To assure that the propeller remains secure on the shaft during the season, periodically check propeller shaft nut for tightness.

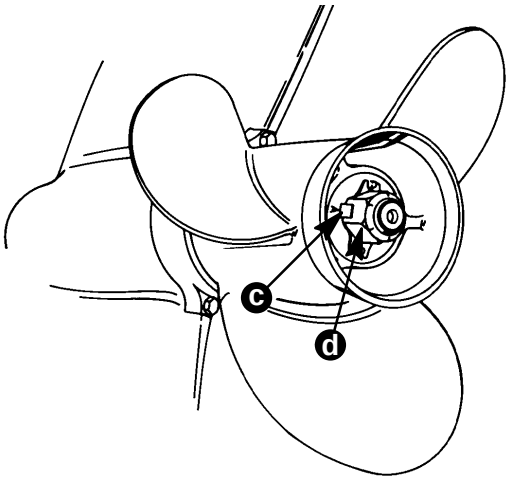
1. To aid in future removal of the propeller, liberally coat the propeller shaft spline with one of the following Quicksilver lubricants:
   – Anti-Corrosion Grease
   – 2-4-C Marine Lubricant
   – Special Lubricant 101
2. Place forward thrust hub on propeller shaft.



50551

a - Thrust Hub
b - Propeller Shaft

3. While aligning splines, place Quicksilver propeller and tab washer on propeller shaft in this order.
4. To prevent propeller from rotating, place a flat block of wood between the anti-ventilation plate and the propeller.
5. Thread propeller nut on propeller shaft, tighten securely with wrench [minimum of 55 lb. ft. (74.5 N·m) of torque] and bend on tab washer to secure propeller nut.
6. After first use, bend the tab straight, retighten propeller nut [minimum of 55 lb. ft. (74.5 N·m) of torque] and again bend tab washer to secure nut. Check propeller periodically for tightness.



51119

c - Tab Washer
d - Propeller Nut

Installing and Removing Propeller

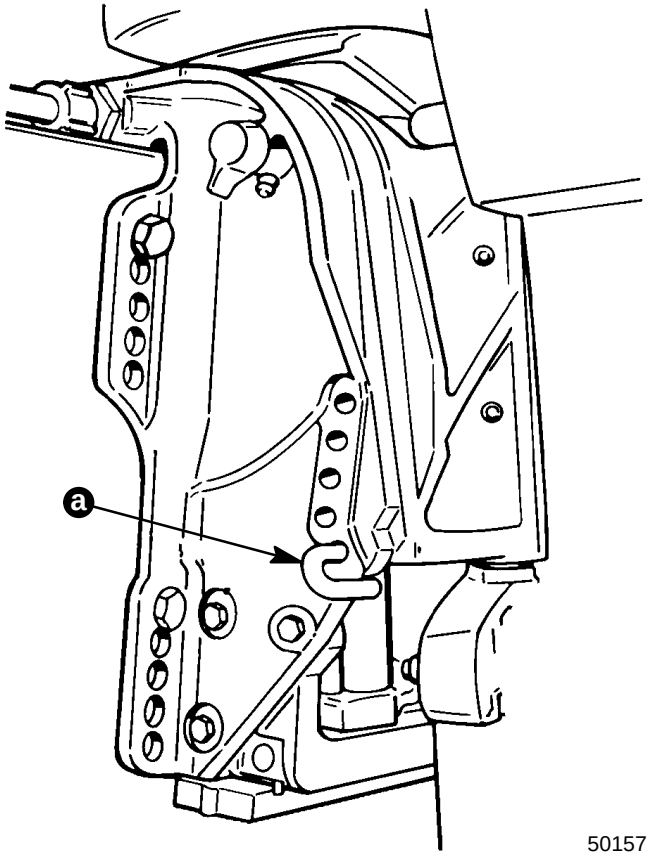
Trim “In” Angle Adjustment

⚠ WARNING

Operating some boats with outboard trimmed to the full “in” trim angle [not using trim adjustment bolt (a)] at planing speed will cause undesirable and/or unsafe steering conditions. Each boat must be water tested for handling characteristics after outboard installation and after any trim adjustments.

IMPORTANT: Some boat/outboard combinations, that do not use the trim adjustment pin (a) and are trimmed to the full “in” trim angle, will not experience any undesirable and/or unsafe steering conditions during planing speed. Thus, not using trim adjustment pin may be desired. However, some boats with outboard trimmed to the full “in” trim angle at planing speeds will cause undesirable and/or unsafe steering conditions. If these steering conditions are experienced, under no circumstances should the outboard be operated without the trim adjustment pin and without the pin adjusted in the proper holes to prevent unsafe handling characteristics.

Water test the boat not using the trim adjustment pin. If undesirable and/or unsafe steering conditions are experienced (boat runs with nose down), install trim adjustment pin in proper hole to prevent unsafe handling characteristics.



50157

Propeller Information Chart

50/55 MODELS

Wide Open Throttle RPM: 5000-5500
Recommended Transom Height: Short Shaft 16-1/2 in. (41.9 cm), Long Shaft 21 in. (53.3 cm)
Right Hand Rotation
Gear Reduction: 1.64:1
Thrust Hub: 73345A 1

Diameter	Pitch	No. of Blades	Material	Approx. Gross Boat Wgt. (Lbs.)	Approx. Boat Length	Speed Range (MPH)	Propeller Part Number
10″	19″	3	Alum	Up to 700	Up to 14′	48-55	48-73146A40
10″	17″	3	Alum	Up to 800	Up to 15′	44-51	48-73144A40
10″	16″	3	Steel	700-900	Up to 15′	41-48	48-91818A5
10″	16″	3	Alum	700-900	Up to 15′	41-48	48-73142A40
10.13″	15″	3	Steel	800-1100	13′ to 15′	38-45	48-76232A5
10.13″	15″	3	Alum	800-1100	13′ to 15′	38-45	48-73140A40
10.38″	14″	3	Alum	900-1300	14′ to 16′	35-41	48-816706A40
10-1/4″	14″	3	Steel	900-1300	14′ to 16′	35-41	48-76230A5
10.38″	13″	3	Steel	1000-1500	14′ to 17′	32-38	48-76228A5
10-1/2″	13″	3	Alum	1000-1500	14′ to 17′	32-38	48-816704A40
10.63″	12″	3	Steel	1100-1700	15′ to 17′	28-34	48-79792A5
10-3/4″	12″	3	Alum	1100-1700	15′ to 17′	28-34	48-816702A40
10.88″	11″	3	Alum	1200-1900	16′ to 18′	24-30	48-85632A40
12″	10-1/2″	3	Alum	1400-2100	16′ +	22-28	48-42740A10
11-1/4″	10″	3	Alum	1500-2300	17′ +	20-26	48-73132A40
12-1/4″	9″	3	Steel	1800 +	18′ +	14-22	48-97868A5
12-1/4″	9″	3	Alum	1800 +	18′ +	14-22	48-87818A10
12-1/2″	8″	3	Alum	2100 +	18′ +	1-18	48-42738A10

60 MODELS

Wide Open Throttle RPM: 5000-5500
Recommended Transom Height: Short Shaft 16-1/2 in. (41.9 cm), Long Shaft 20 in. (53.3 cm)
Right Hand Rotation
Gear Reduction: 1.64:1
Thrust Hub: 73345A 1

Diameter	Pitch	No. of Blades	Material	Approx. Gross Boat Wgt. (Lbs.)	Approx. Boat Length	Speed Range (MPH)	Propeller Part Number
10″	19″	3	Alum	Up to 800	Up to 14′	48-55	48-73146A40
10″	17″	3	Alum	Up to 1000	Up to 15′	44-51	48-73144A40
10″	16″	3	Steel	700-1100	Up to 15′	41-48	48-91818A5
10″	16″	3	Alum	700-1100	Up to 15′	41-48	48-73142A40
10.13″	15″	3	Steel	800-1200	13′ to 15′	38-45	48-76232A5
10.13″	15″	3	Alum	800-1200	13′ to 15′	38-45	48-73140A40
10.38″	14″	3	Alum	900-1500	14′ to 16′	35-41	48-816706A40
10-1/4″	14″	3	Steel	900-1500	14′ to 16′	35-41	48-76230A5
10.38″	13″	3	Steel	1200-1800	15′ to 17′	32-38	48-76228A5
10-1/2″	13″	3	Alum	1200-1800	15′ to 17′	32-38	48-816704A40
10.63″	12″	3	Steel	1500-2100	16′ to 18′	28-34	48-79792A5
10-3/4″	12″	3	Alum	1500-2100	16′ to 18′	28-34	48-816702A40
10.88″	11″	3	Alum	1800-2400	16′ to 18′	24-30	48-85632A40
12″	10-1/2″	3	Alum	2000-2600	17′ +	22-28	48-42740A10
11-1/4″	10″	3	Alum	2100-2600	17′ +	20-26	48-73132A40
12-1/4″	9″	3	Steel	2400 +	18′ +	14-22	48-97868A5
12-1/4″	9″	3	Alum	2400 +	18′ +	14-22	48-87818A10
12-1/2″	8″	3	Alum	2800 +	19′ +	1-18	48-42738A10

Propeller Information Chart

60 BIG FOOT, 60 SEAPRO/MARATHON MODELS

Wide Open Throttle RPM: 5000-5500
Recommended Transom Height: Short Shaft 16-1/2 in. (41.9 cm), Long Shaft 21 in. (53.3 cm), Extra Long Shaft 23-1/2 in. (59.7cm)
Right Hand Rotation, 4-1/4 in. Gear Case Torpedo
Gear Reduction: 2.3:1
Thrust Hub : 13191A1

Diameter	Pitch	No. of Blades	Material	Approx. Gross Boat Wgt. (Lbs.)	Approx. Boat Length	Speed Range (MPH)	Propeller Part Number
12-3/4″	26″	5	Steel	Up to 800	Up to 15′	48-55	48-815748A40
13-1/2″	26″	3	Steel	Up to 800	Up to 15′	48-54	48-16996A40
12-3/4″	24″	5	Steel	Up to 1000	Up to 15′	46-52	48-815746A40
13-1/2″	24″	3	Steel	Up to 1000	Up to 15′	46-52	48-16994A40
12-1/2″	23″	3	Alum	700-1100	Up to 15′	45-51	48-77350A40
12-3/4″	22″	5	Steel	700-1100	Up to 15′	43-49	48-815744A40
13-1/2″	22″	3	Steel	700-1100	Up to 16′	43-49	48-16992A40
12-3/4″	21″	3	Alum	800-1200	13′ to 16′	40-47	48-77348A40
12-3/4″	20″	5	Steel	800-1200	13′ to 16′	38-45	48-816612A40
13-1/2″	20″	3	Steel	800-1200	13′ to 16′	38-45	48-16990A40
13″	19″	3	Alum	1000-1500	14′ to 17′	35-42	48-77346A40
13″	18″	3	Steel	1000-1500	14′ to 17′	33-40	48-16988A 5
13-1/4″	17″	3	Alum	1300-1800	15′ to 18′	31-38	48-77344A40
13-1/8″	16″	3	Steel	1300-1800	15′ to 18′	29-36	48-16986A 5
13-3/4″	15″	3	Alum	1600-2200	16′ to 19′	26-33	48-77342A40
13-3/8″	14″	3	Steel	1600-2200	16′ to 19′	23-31	48-17314A 5
14″	13″	3	Alum	2000-2600	17′ +	20-28	48-77340A40
14″	12″	3	Steel	2000-2600	17′ +	17-26	48-17312A 5
14″	11″	3	Alum	2400 +	18′ +	1-22	48-77338A40
14″	10″	3	Steel	2800 +	19′ +	1-20	48-17310A 5

50-60 MODELS

Stainless Steel Race Propellers – Available from Mercury Performance Products

Diameter	Pitch	No. of Blades	Rotation	Propeller Part Number
11″	18″	3	RH	48-66106
11″	20″	3	RH	48-66108
11″	22″	3	RH	48-66110

GENERAL INFORMATION:

Propeller-Drive Hub: 43676

Diffuser Rings: Alum Propellers – 32201

Power Trim System (Models with Power Trim)

GENERAL INFORMATION

NOTE: *50/60 models are not equipped with Trim System Design I. See chart below.*

Model	Design I	Design II	Design III
40 (4cyl)	**X**	**X**	**X**
50/60		**X**	**X**

The power trim system is filled at the manufacturer and is ready for use.

Trim outboard through entire trailering range several times to remove any air from the system.

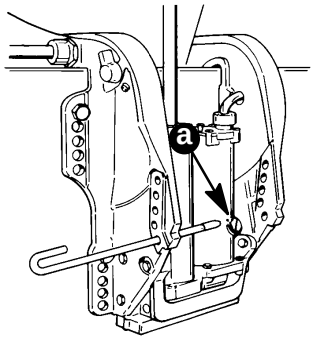
The trim system is pressurized and is not externally vented.

The outboard can be raised or lowered manually by loosening the manual release valve 2 to 3 turns counterclockwise.

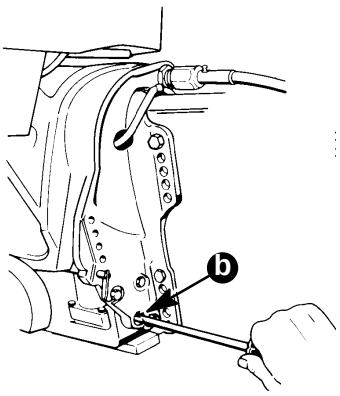
The trim “out” angle of this outboard is not adjustable. The trim system has an internal valve which will automatically stop the outward trim travel at 20° when engine RPM is approximately 2000 RPM or higher; outboard also has to be in water and in gear.

The outboard can be operated beyond the 20° trim limit for operating outboard in shallow water if engine RPM is kept below approximately 2000 RPM.

Trim System Design II

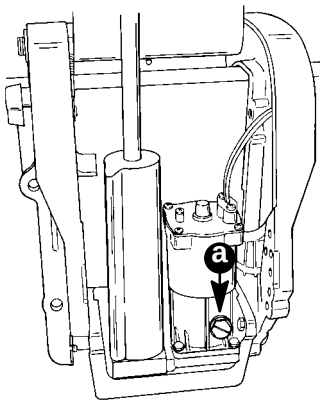


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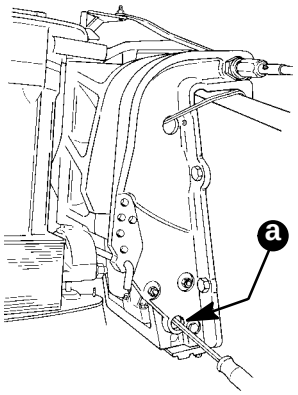


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Trim System Design III



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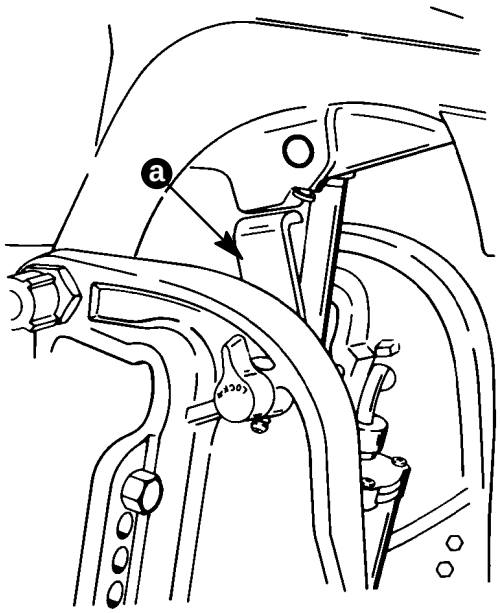
52028

a - Fill Screw (System is Pressurized, DO NOT Open Unless Outboard is Tilted to Full Up Position)
b - Manual Tilt Release Valve Location

CHECKING TRIM SYSTEM FLUID LEVEL

IMPORTANT: This trim system is pressurized. Remove fill screw when outboard is trimmed to the full "up" position. Retighten fill screw securely.

1. Trim outboard to full "up" position. Engage tilt lock lever (a). Trim system fluid can only be checked when outboard is in this position.



50157

2. Remove fill screw and check fluid level. Fluid level should be to bottom of threads in fill hole (b).
3. If necessary, add Quicksilver Power Trim & Steering Fluid or; Automatic Transmission Fluid (ATF) Type F, FA or Dexron II fluid to trim system.
4. Reinstall fill screw.

Trimming (Models with Power Trim)

NOTE: *Because varying hull designs react differently in various degrees of rough water, it is recommended to experiment with trim positions to determine whether trimming up or down will improve the ride in rough water.*

When trimming your outboard from a mid-trim position (trim tab in neutral straight fore-and-aft position), you can expect the following results:

TRIMMING OUTBOARD "OUT" ("UP") CHARACTERISTICS

⚠ WARNING

Excessive trim "out" also may reduce the stability of some high speed hulls. To correct instability at high speed, reduce the power GRADUALLY and trim the outboard "in" slightly before resuming high speed operation. (Rapid reduction in power will cause a sudden change of steering torque and may cause additional momentary boat instability.)

1. Will lift bow of boat, generally increasing top speed.
2. Transfers steering torque harder to left on standard or slightly elevated transom installation (single outboard).
3. Increases clearance over submerged objects.
4. In excess, can cause porpoising and/or ventilation.
5. If trimmed out beyond the water pickup, reduced water supply can cause serious overheating.

TRIMMING OUTBOARD "IN" ("DOWN") CHARACTERISTICS

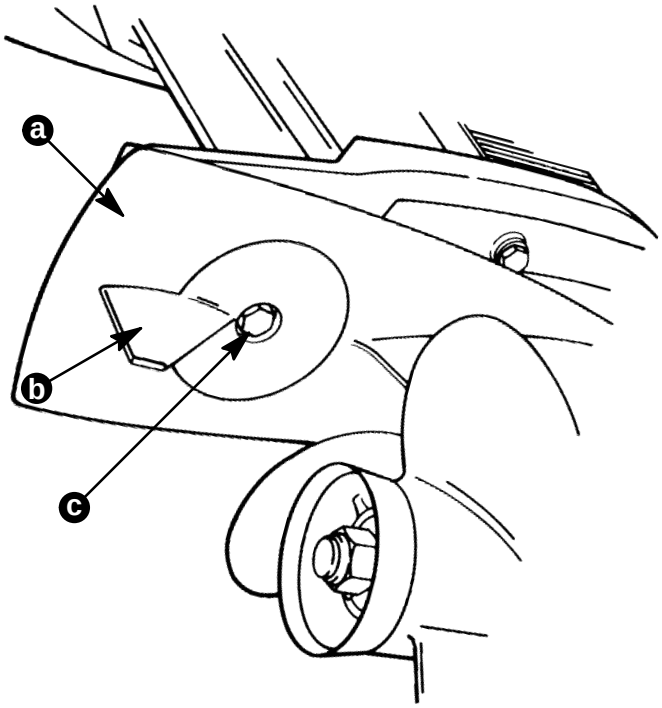
⚠ WARNING

Excessive speed at minimum trim "in" may cause undesirable and/or unsafe steering conditions. Each boat should be tested for handling characteristics after any adjustment is made to the trim angle (trim adjustment pin relocation).

1. Will help planing off, particularly with a heavy load.
2. Usually improves ride in choppy water.
3. In excess, can cause boat to veer to the left or right (bow steer).
4. Transfers steering torque harder to right (or less to the left) on single outboard installations.
5. Improves planing speed acceleration.

Trim Tab Adjustment

1. Check trim tab position as follows:
   a. Operate boat at the speed at which it would normally be operated.
   b. If the boat pulls to the right (starboard), the trailing edge of trim tab must be moved to the right. If the boat pulls to the left (port), the trailing edge of trim tab must be moved to the left.
2. If necessary, adjust trim tab as follows:
   a. Shift outboard control into neutral and turn ignition key to “Off” position.
   b. Loosen bolt (c) and trim tab (b).
   c. If boat pulls to the left, adjust trailing edge of trim tab to the left. If boat pulls to the right, adjust trailing edge of trim tab to the right.
   d. Tighten trim tab bolt securely.
   e. Operate boat per “Check trim tab position as follows,” to check trim tab setting. If necessary readjust trim tab.



50553

a - Anti-Ventilation Plate
b - Adjustable Trim Tab
c - Bolt

Boat Performance

TEST INSTRUCTIONS

⚠ WARNING

A tight grip on the steering wheel/tiller handle is always advisable and is required when accelerating, decelerating or when trimming the boat. On models with Power Trim, upon reaching cruising speed, the outboard should be trimmed to obtain a balanced steering condition. While trimming, steering loads will vary and will pull in one direction until a balanced condition has been attained. If the outboard is trimmed past the balanced steering condition, the steering wheel/tiller handle then will have a tendency to pull in the opposite direction. Excessive trimming past the balanced steering position will result in increased steering loads and, in most boat applications, a decrease in performance.

⚠ CAUTION

When trimming boat with dual outboards, both outboards should be at approximately the same tilt angle and be tilted out (up) simultaneously (to prevent boat from veering side-to-side) until desired boat attitude is achieved. Outboards can then be trimmed individually to precisely adjust boat trim angle and pitch.

1. With boat in water, trim the outboard(s) (trim button in remote control handle) so that the decal on the side of cowl is horizontal. This is a typical average setting that should give reasonable acceleration and top speed.
2. Go for a short familiarization ride at various throttle and trim settings BEFORE starting testing.

NOTE: *Instruments should be read with eye directly in front to eliminate any error in reading the instruments.*

3. When making either top speed or acceleration runs, best accuracy will be obtained by running with or against any wind. Side winds require driving in a constant turn to keep the boat moving straight-ahead. If winds are 10 MPH (16 km/hr) or greater, it is suggested that all acceleration runs be made downwind.
4. The top speed WOT (wide-open-throttle) test should be done with the boat normally loaded (to duplicate actual running conditions). Operate boat in gear at WOT and check RPM. Engine RPM must be within the recommended full throttle RPM range (listed in the Operation and Maintenance Manual).

NOTE: *When performing an acceleration test, it is recommended that a stop watch be used to improve testing accuracy. A wrist watch with a second hand may also be substituted.*

BOAT TEST CHART (Example)

Propeller Diameter and Pitch	WOT RPM *	WOT MPH *	Acceleration Time in Seconds	Propeller Break Loose		Wind during Run		Water Condition	Air Temperature (°F)	Comments
				During Acceleration	During Turns	Direction	MPH			
10 1/8" x 15	*5450*	*35*	*7*	*slight*	*no*		*5*	*3"*	*73*	
10 1/4" x	*5700*	*34*	*6*	*no*	*no*		*5*	*chop*	*73*	

*WOT is wide-open-throttle

5. An acceleration test can also be performed if desired. Start the test with boat motionless in the water and outboard in neutral. A stop watch should be started as the throttle is quickly pushed to WOT (wide-open-throttle). Stop the watch as the speedometer needle sweeps past 20 MPH (32 km/hr). Several runs should be made to assure a good average.
6. Prop "break loose" (sudden higher RPM), if not excessive, in some cases can be beneficial during acceleration. If undesirable "break loose" occurs, it can be decreased by trimming the outboard further under. If it remains excessive with all similar propellers, the outboard must be lowered.
7. It is suggested that all applicable data be recorded on a chart (such as that illustrated, above) and retained for future reference.
8. After several propellers of different pitch and/or design have been tried, select one that best serves the general purpose of the boat. The selected propeller should enable the engine to operate within its recommended full throttle RPM range, without excessive propeller "break loose" during acceleration or turns. A second propeller that would make both a suitable spare or a special purpose alternate might also be desirable.

NOTE: *A higher pitch often gives best top speed, but the next lower pitch gives adequate top speed with much better acceleration.*

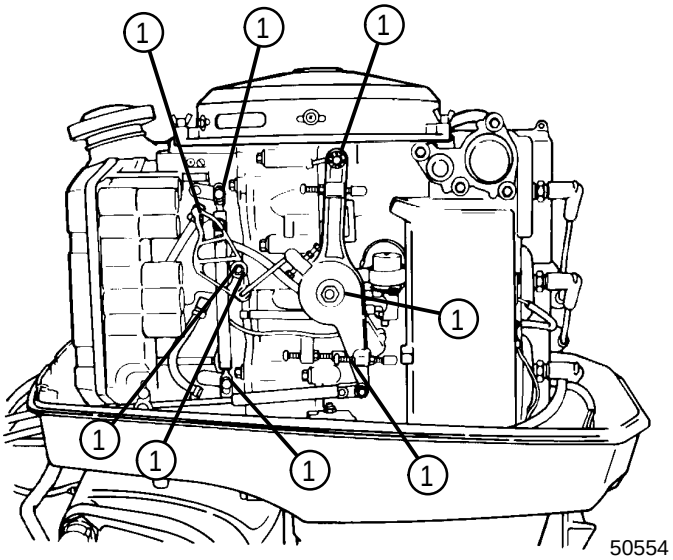
Lubrication Points

Item No.	Description	Type of Lubricant	Fresh Water Frequency	Salt Water Frequency
1	Throttle/Shift Linkage Pivot Points	Quicksilver 2-4-C w/Te-flon Marine Lubricant	Every 60 Days	Every 30 Days
2	Upper Shift Shaft			
3	Swivel Pin			
4	Ride Guide Steering Cable			
5	Tilt Tube			
6	Steering Link Rod Pivot Points	SAE 30W Motor Oil	Every 60 Days	Every 30 Days
7	Propeller Shaft	Quicksilver -Anti-Corro-sion Grease	Once in Season	Every 60 Days
8	Starter Motor Pinion Gear	SAE 30W Motor Oil	Once in Season	Every 60 Days
9 *	Gear Housing Bearing Carrier	Quicksilver 2-4-C w/Te-flon Marine Lubricant		After first 20 Hours, then once in season
10 ◊	Gear Housing	Quicksilver Gear Lube	Check and fill after first 10 days, then every 30 days	Check and fill after first 10 days, then every 30 days
			Drain and re-fill after 1st 25 hours, then after every 100 hours, or once a year before storing	Drain and re-fill after 1st 25 hours, then after every 100 hours, or once a year before storing
Δ	Engine Crankshaft Splines to Drive Shaft Splines	Quicksilver 2-4-C w/Te-flon Marine Lubricant	Once in Season	Once in Season

* Refer to lubrication instructions outlined in “Salt Water Corrosion - Gear Housing Bearing Carrier and Cover Nut” of this section (see “Table of Contents”).

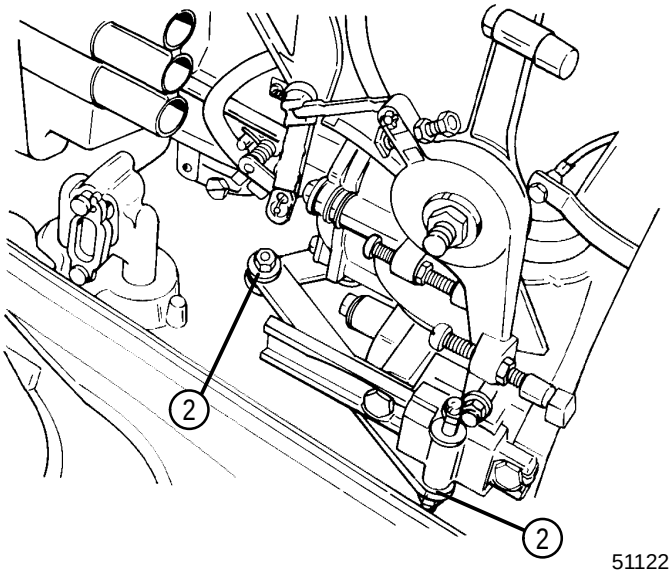
◊ Refer to “Gear Housing Lubrication” of this section (see “Table of Contents”).

Δ Refer to “Gear Housing Removal and Installation” (Section 5).



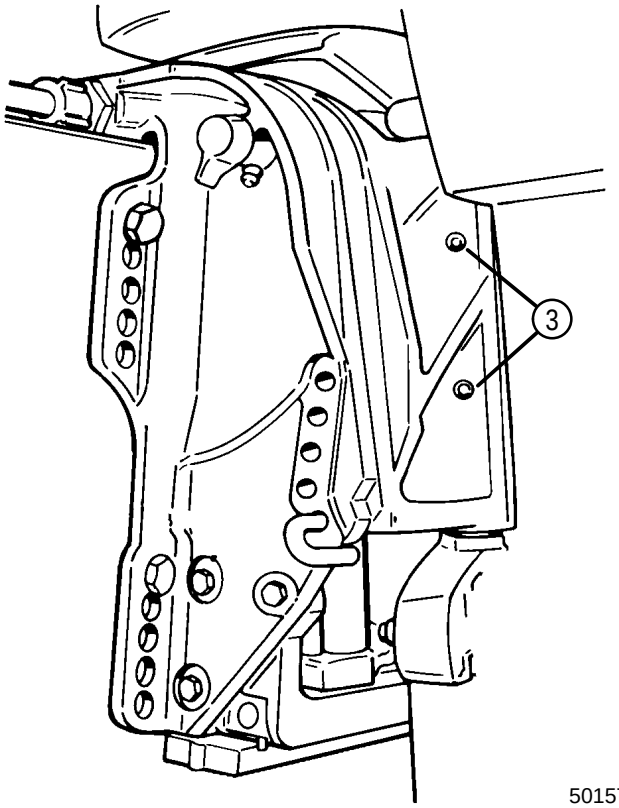
50554

1 - Throttle/Shift Linkage Pivot Point Lubrication



51122

2 - Upper Shift Shaft Lubrication



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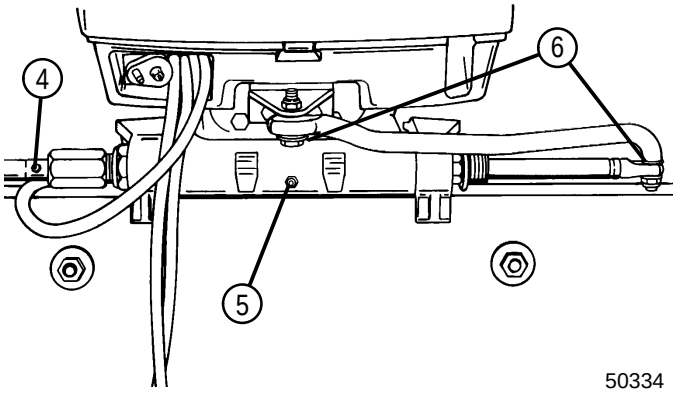
3 - Swivel Pin Grease Fittings

RIDE GUIDE STEERING CABLE and PIVOT POINTS LUBRICATION

⚠ WARNING

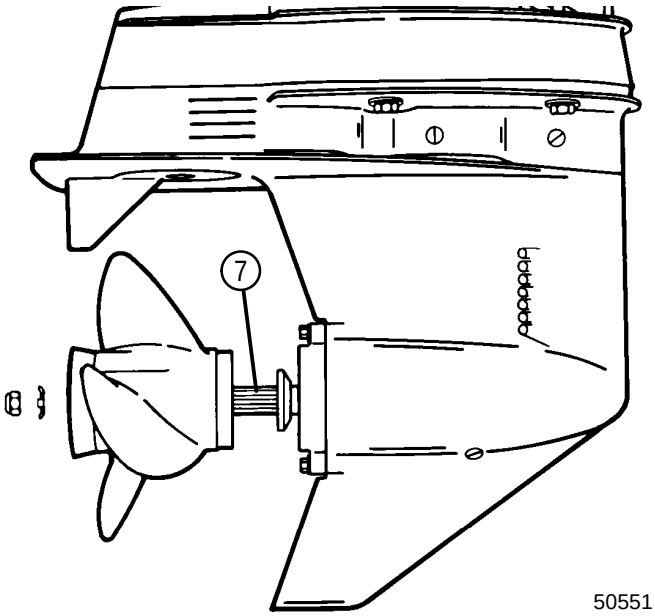
Core of steering cable (transom end) must be fully retracted into cable housing before lubricating cable. If cable is lubricated while extended, hydraulic lock of cable could occur.

With core of Ride Guide Steering cable (transom end) fully retracted, lubricate transom end of steering cable thru grease fitting and exposed portion of cable end with Quicksilver 2-4-C Marine Lubricant. Lubricate all pivot points with SAE 30W engine oil.



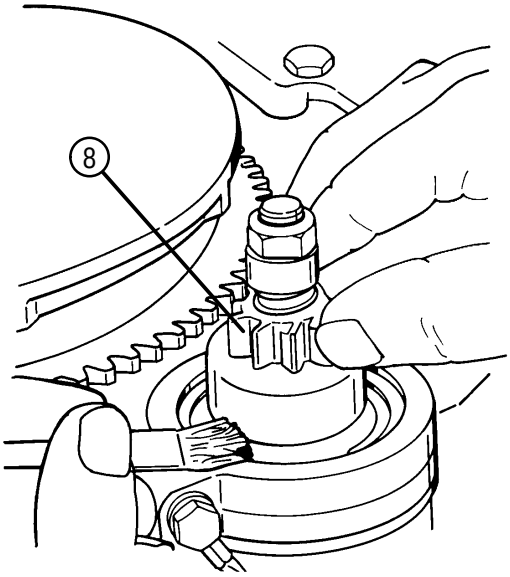
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4 - Ride Guide Steering Grease Fitting
5 - Tilt Tube Grease Fitting
6 - Steering Link Rod Pivot Point Lubrication



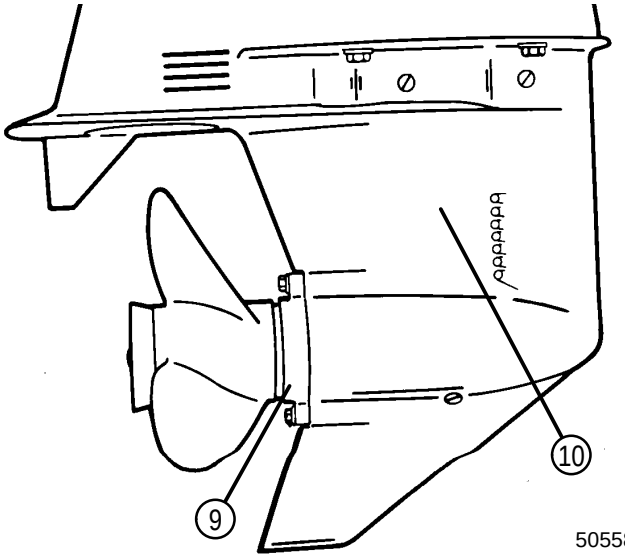
50551

7 - Propeller Shaft Lubrication (a)



51118

8 - Rotate Starter Motor Pinion Gear To Expose Shaft and Lubricate



50558

Gear Housing Lubrication

GEAR HOUSING LUBRICATION

NOTE: *Refer to "Specifications," for gear housing lubricant capacity.*

⚠ WARNING

If gear housing is installed on outboard, to avoid accidental starting, disconnect (and isolate) spark plug leads from spark plugs before working near the propeller.

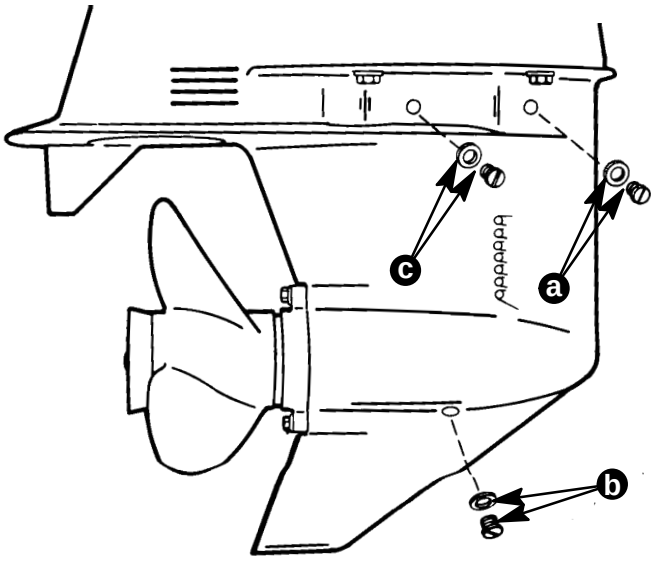
⚠ CAUTION

Do not use automotive grease in the gear housing. Use only Quicksilver Gear Lube or Quicksilver Super-Duty Lower Unit Lubricant.

1. Tilt outboard so that lubricant in gear housing will drain toward front of housing, out fill hole and into clean container.

IMPORTANT: Inspect FILL and VENT plug washers for damage. Use new washer as needed.

2. Remove lubricant fill plug and washer. Note amount of metal particles on magnetic fill plug.
3. Remove VENT plugs and washers (a and c) and allow all lubricant to drain.



50558

a - Lubricant VENT Plug/Washer
b - Lubricant Fill Plug/Washer
c - Lubricant VENT Plug/Washer

4. Inspect gear lubricant for metal particles (lubricant will have a "metal flake" appearance). Presence of fine metal particles (resembling powder) on the FILL plug bar magnet indicates normal wear. The presence of metal chips on the drain plug bar magnet indicates the need for gear housing disassembly and components inspection.
5. Note color of gear lubricant. White or cream color indicates presence of water in lubricant. Gear lubricant which has been drained from a gear housing recently in operation will have a yellowish color due to lubricant agitation/aeration. This is normal and should not be confused with the presence of water.
6. Presence of water in gear lubricant indicates the need for disassembly and inspection of oil seals, seal surfaces, O-rings, water pump gaskets as well as gear housing components for damage.

IMPORTANT: Never add lubricant to gear housing without first removing VENT plugs, as trapped air will prevent housing from being filled. Fill gear housing only when outboard is in operating position.

7. With outboard in operating position, insert lubricant tube into fill hole.
8. Fill gear housing until excess lubricant flows from forward VENT hole.
9. Install VENT plug and washer (a).
10. Continue to fill gear housing until lubricant flows from VENT hole.
11. Install VENT plug and washer (c).
12. Clean magnet on FILL plug and install FILL plug and washer (b).

SALT WATER CORROSION - GEAR HOUSING BEARING CARRIER and COVER NUT

Salt water corrosion buildup can be sufficient to split a gear housing and destroy an entire lower unit. To protect against such damage, therefore, it is recommended that the gear housing bearing carrier be lubricated on a regular basis, as follows:

Service first at the 20-hour inspection, then on an annual basis. Remove the entire bearing carrier to adequately clean corrosive deposits and dried-up lubricant from both ends of the bearing carrier, as well as the gear housing. Apply a liberal amount of 2-4-C w/Teflon Marine Lubricant to the 2 ends of the bearing carrier, then reassemble and torque to specifications. Refer to gear housing disassembly and reassembly (Section 6A).

Periodic Inspection

Conduct a periodic, systematic inspection to uncover and correct a failure before it can cause inconvenience or mechanical damage. Inspection interval is based on average operating conditions in recreation service. Under severe conditions, the inspection interval should be shortened. Inspection includes:

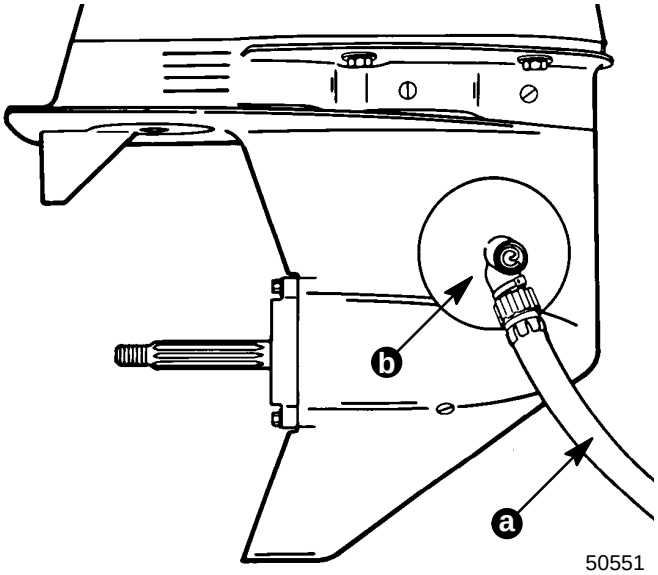
1. Clean entire unit thoroughly, including all accessible powerhead parts.
2. Check entire unit for loose, damaged or missing parts. Tighten or replace as required.
3. Lubricate gear housing.
4. Lubricate other points as indicated, previously.
5. Lubricate starter motor shaft with light film of SAE 10W motor oil. **Do not over-lubricate.**
6. Service spark plugs. Inspect spark plug leads and electrical leads for damage or deterioration, as explained in Section 2 “Electrical and Ignition”.
7. Inspect fuel lines for damage or deterioration and service fuel filters as indicated in Section 3 “Fuel System and Carburetion.”
8. Remove propeller and inspect. Trim nicks and burrs with a file, being careful not to remove more metal than absolutely necessary. Inspect for cracks, damage or bent condition. If condition is doubtful, refer to authorized Quicksilver Propeller Repair Station facilities. Before reinstalling propeller, coat propeller shaft with Quicksilver Special Lubricant 101, Anti-Corrosion Grease or 2-4-C w/Teflon Marine Lubricant.
9. Inspect the outboard surface finish for damage or corrosion. Thoroughly clean damaged or corroded areas and apply matching paint (Quicksilver Spray Paints).
10. Check trim tab and galvanic corrosion sacrificial anode for damage or for deterioration from salt water operation.
11. Check remote controls and steering. Be sure that all connections and fittings are in good condition, properly secured and correctly adjusted.

Flushing Outboard Cooling System

⚠ WARNING

When flushing, be certain that area in vicinity of propeller is clear and that no person is standing nearby – to avoid possible injury. It is recommended to remove propeller as a precautionary measure.

1. Install Quicksilver Flushing Attachment (73971A2) [or equivalent tool] on the gear housing from the FRONT side, positioning the rubber cups over the water intake openings.



a - Water Hose (1/2 in. [13mm] I.D. or Larger)
b - Flushing Attachment (73971A2)

(Typical Gear Housing)

2. Connect hose (1/2 in. [13mm] I.D. or larger) between flushing attachment and water tap.

IMPORTANT: To prevent water pump damage, do not start or run engine unless cooling water is flowing.

3. With the outboard in normal operating position (vertical), partially open water tap (IT MAY NOT BE NECESSARY to use full water pressure) and adjust water flow so that there is a significant water loss around the rubber cups.

4. Start engine and idle in neutral. Then increase engine speed, not to exceed 2500 RPM.
5. Flush or service engine as required. Be sure adequate cooling water is provided.
    a. Water must be discharged thru “tell-tale outlet.”

IMPORTANT: Prevent engine overheating. If water flow is insufficient, stop engine and determine cause before continuing.

    b. Flush until discharged water is clear. In saltwater areas, run outboard 3 to 5 minutes.
    c. Stop engine before turning off water.
6. Stop engine, turn water off and remove flushing attachment from gear housing.

IMPORTANT: While and after flushing, keep outboard in upright position until all water has drained from drive shaft housing to prevent water from entering the powerhead via drive shaft housing and exhaust ports.

Following Complete Submersion

Submerged engine treatment is divided into 3 distinct problem areas. The most critical is submersion in salt water; the second is submersion while running.

SALT WATER SUBMERSION (SPECIAL INSTRUCTIONS)

Due to the corrosive effect of salt water on internal engine components, complete disassembly is necessary before any attempt is made to start the engine.

SUBMERGED WHILE RUNNING (SPECIAL INSTRUCTIONS)

When an engine is submerged while running, the possibility of internal engine damage is greatly increased. If, after engine is recovered and with spark plugs removed, engine fails to rotate freely when turning flywheel, the possibility of internal damage (bent connecting rod and/or bent crankshaft) exists. If this is the case, the powerhead must be disassembled.

SUBMERGED ENGINE (FRESH WATER) (PLUS SPECIAL INSTRUCTIONS)

1. Recover engine as quickly as possible.
2. Remove cowling.
3. Flush exterior of outboard with fresh water to remove mud, weeds, etc. DO NOT attempt to start engine if sand has entered powerhead, as powerhead will be severely damaged. Disassemble powerhead if necessary to clean components.
4. Remove spark plugs and get as much water as possible out of powerhead. Most water can be eliminated by placing engine in a horizontal position (with spark plug holes down) and rotating flywheel.
5. Pour alcohol into carburetor throat (alcohol will absorb water). Again rotate flywheel.
6. Turn engine over and pour alcohol into spark plug openings and again rotate flywheel.
7. Turn engine over (place spark plug openings down) and pour engine oil into throats of carburetors while rotating flywheel to distribute oil throughout crankcase.
8. Again turn engine over and pour approximately one teaspoon of engine oil into each spark plug opening. Again rotate flywheel to distribute oil in cylinders.
9. Remove and clean carburetors and fuel pump assembly.
10. Reinstall spark plugs, carburetors and fuel pump.
11. Attempt to start engine, using a fresh fuel source. If engine starts, it should be run for at least one hour to eliminate any water in engine.
12. If engine fails to start, determine cause (fuel, electrical or mechanical). Engine should be run within 2 hours after recovery of outboard from water, as serious internal damage may occur. If unable to start engine in this period, disassemble engine and clean all parts and apply oil as soon as possible.

Out-of-Season Outboard Storage

⚠ WARNING

As a safety precaution, when boat is in storage, remove positive (+) battery cable. This will eliminate possibility of accidental starting of engine and resultant overheating and damage to engine from lack of water.

In preparing an outboard for out-of-season storage, 2 precautions must be considered: 1) The engine must be protected from physical damage and 2) the engine must be protected from rust, corrosion and dirt.

1. Remove cowling from engine.
2. Place outboard in water or install Quicksilver Flushing Attachment over water intake by following instructions outlined in “Flushing Cooling System” (see “Table of Contents”).
3. Start engine and allow to warm up. Disconnect fuel line. When engine starts to stall quickly spray Quicksilver Storage Seal into each carburetor throat. Continue to spray until engine dies from lack of fuel.
4. Remove spark plugs and inject a 5 second spray of Quicksilver Storage Seal around the inside of each cylinder. Manually turn engine over several times to distribute Storage Seal throughout cylinders. Reinstall spark plugs.
5. If engine fuel filter appears to be contaminated, remove and replace. Refer to Section 3 “Fuel System and Carburetion.”
6. Drain and refill lower unit with Quicksilver Gear Lube, as explained in “Gear Housing Lubrication” (see “Table of Contents”).
7. Clean outboard thoroughly, including all accessible powerhead parts, and spray with Corrosion and Rust Preventive.
8. Refer to lubrication chart in this section (see “Table of Contents”) and lubricate all lubrication points.
9. Remove propeller. Apply Quicksilver Special Lubricant 101, Anti-Corrosion Grease or 2-4-C w/Teflon Marine Lubricant to propeller shaft and reinstall propeller. Refer to “Propeller Installation” (see “Table of Contents”).
10. If the water pickup is clogged, the speedometer will be inoperative. Clean the pickup with a piece of wire or blow out with compressed air. Before blowing out with air, disconnect the tubing from the speedometer.
11. To prevent freeze damage, drain the speedometer system of water completely before storage. Remove tubing from speedometer fitting and blow thru the tubing to remove water.
12. Store battery as outlined in “Out-of-Season Battery Storage,” following.
13. For out-of-season storage information on Autoblend units, refer to Section 8 in this service manual.

IMPORTANT: When storing outboard for the winter, be sure that all water drain holes in gear housing are open and free so that all water will drain out. If a speedometer is installed in the boat, disconnect the pickup tube and allow it to drain. Reconnect the tube after draining. Trapped water may freeze and expand, thus cracking gear housing and/or water pump housing. Check and refill gear housing with Quicksilver Gear Lube before storage to protect against possible water leakage into gear housing which is caused by loose lubricant vent plug or loose grease fill plug. Inspect gaskets under lubricant vent and fill plugs, replacing any damaged gaskets, before reinstalling plugs.

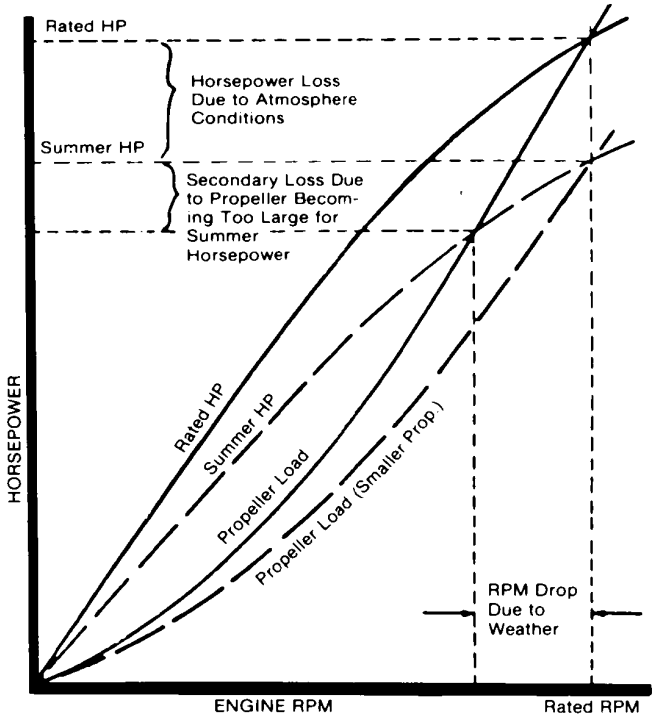
Out-of-Season Battery Storage

1. Remove battery as soon as possible and remove all grease, sulfate and dirt from top surface.
2. Cover PLATES with distilled water, but not over 3/16 in. (5mm) above perforated baffles.
3. Cover terminal bolts well with grease.
4. Store battery in a COOL, DRY place in a dry carton or box.
5. Remove battery from storage every 60 days. Check water level and place on charge for 5 to 6 hours at 6 amperes. DO NOT fast charge.

⚠ CAUTION

A discharged battery can be damaged by freezing.

How Weather Affects Engine Performance



It is a known fact that weather conditions exert a profound effect on power output of internal combustion engines. Therefore, established horsepower ratings refer to the power that the engine will produce at its rated RPM under a specific combination of weather conditions.

Corporations internationally have settled on adoption of I.S.O. (International Standards Organization) engine test standards, as set forth in I.S.O. 3046 standardizing the computation of horsepower from data obtained on the dynamometer, correcting all values to the power that the engine will produce at sea level, at 30% relative humidity at 77° F (25° C) temperature and a barometric pressure of 29.61 inches of mercury.

Summer Conditions of high temperature, low barometric pressure and high humidity all combine to reduce the engine power. This, in turn, is reflected in decreased boat speeds--as much as 2 or 3 miles-per-hour (3 or 5 Km per-hour) in some cases. (Refer to previous chart.) Nothing will regain this speed for the boater, but the coming of cool, dry weather.

In pointing out the practical consequences of weather effects, an engine--running on a hot, humid summer day--may encounter a loss of as much as 14% of the horsepower it would produce on a dry, brisk spring or fall day. The horsepower, that any internal combustion engine produces, depends upon the density of the air that it consumes and, in turn, this density is dependent upon the temperature of the air, its barometric pressure and water vapor (or humidity) content.

Accompanying this weather-inspired loss of power is a second but more subtle loss. At rigging time in early spring, the engine was equipped with a propeller that allowed the engine to turn within its recommended RPM range at full throttle. With the coming of the summer weather and the consequent drop in available horsepower, this propeller will, in effect, become too large. Consequently, the engine operates at less than its recommended RPM.

Due to the horsepower/RPM characteristics of an engine, this will result in further loss of horsepower at the propeller with another decrease in boat speed. This secondary loss, however, can be regained by switching to a smaller pitch propeller that allows the engine to again run at recommended RPM.

For boaters to realize optimum engine performance under changing weather conditions, it is essential that the engine have the proper propeller to allow it to operate at or near the top end of the recommended maximum RPM range at wide-open-throttle with a normal boat load.

Not only does this allow the engine to develop full power, but equally important is the fact that the engine also will be operating in an RPM range that discourages damaging detonation. This, of course, enhances overall reliability and durability of the engine.

Conditions Affecting Operation

1. Proper positioning of the weight inside the boat (persons and gear) has a significant effect on the boat's performance, for example:
   a. Shifting weight to the rear (stern)
      (1) Generally increases top speed.
      (2) If in excess, can cause the boat to porpoise.
      (3) Can make the bow bounce excessively in choppy water.
      (4) Will increase the danger of the following - wave splashing into the boat when coming off plane.
   b. Shifting weight to the front (bow)
      (1) Improves ease of planing off.
      (2) Generally improves rough water ride.
      (3) If excessive, can make the boat veer left and right (bow steer).
2. **Boat Bottom:** For maximum speed, a boat bottom should be nearly a flat plane where it contacts the water and particularly straight and smooth in fore-and-aft direction.
   a. **Hook:** Exists when bottom is concave in fore-and-aft direction when viewed from the side. When boat is planing, "hook" causes more lift on bottom near transom and allows bow to drop, thus greatly increasing wetted surface and reducing boat speed. "Hook" frequently is caused by supporting boat too far ahead of transom while hauling on a trailer or during storage.
   b. **Rocker:** The reverse of hook and much less common. "Rocker" exists if bottom is convex in fore-and-aft direction when viewed from the side, and boat has strong tendency to porpoise.
   c. **Surface Roughness:** Moss, barnacles, etc., on boat or corrosion of outboard's gear housing increase skin friction and cause speed loss. Clean surfaces when necessary.
3. **Gear Housing:** If unit is left in the water, marine vegetation may accumulate over a period of time in certain types of water. This growth must be removed from unit before operation, as it may clog the water inlet holes in the gear housing and cause the engine to overheat.

Detonation: Causes and Prevention

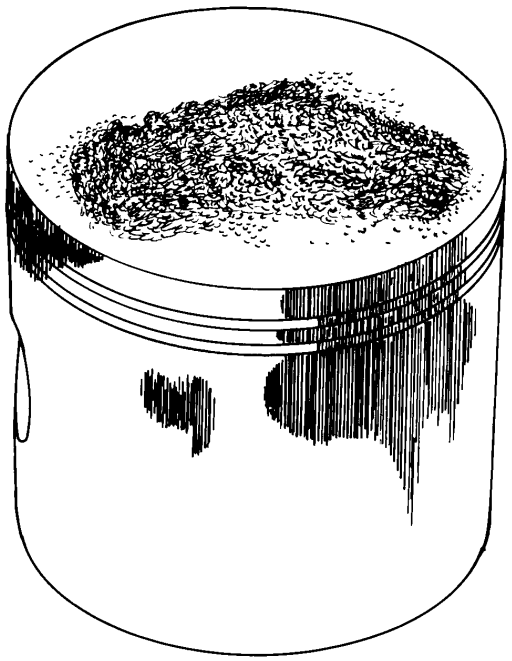
Detonation in a 2-cycle engine somewhat resembles the "pinging" heard in an automobile engine. It can be otherwise described as a tin-link "rattling" or "pinging" sound.

Detonation generally is thought of as spontaneous ignition, but it is best described as a noisy explosion in an unburned portion of the fuel/air charge after the spark plug has fired. Detonation creates severe, untimely, shock waves in the engine, and these shock waves often find or create a weakness: The dome of a piston, piston rings or piston ring lands, piston pin and roller bearings.

While there are many causes for detonation in a 2-cycle engine, emphasis is placed on those causes which are most common in marine 2-cycle application. A few, which are not commonly understood, are:

1. Over-advanced ignition timing.
2. Use of low octane gasoline.
3. Propeller pitch too high (engine RPM below recommended maximum range).
4. Lean fuel mixture at or near wide-open-throttle.
5. Spark plugs (heat range too hot - incorrect reach - cross-firing).
6. Inadequate engine cooling (deteriorated cooling system).
7. Combustion chamber/piston deposits (result in higher compression ratio).

Detonation usually can be prevented, provided that 1) the engine is correctly set up and 2) diligent maintenance is applied to combat the detonation causes, listed, preceding.



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Damaged Piston Resulting from Detonation

Compression Check

1. Remove spark plugs.
2. Install compression gauge (a) in spark plug hole.
3. Hold throttle plates at W.O.T.

4. Crank engine thru at least 4 compression strokes to obtain highest possible reading.
5. Check and record compression of each cylinder. Variation of more than 15 psi. (103.5 kPa) between cylinders indicates that lower compression cylinder is in some way defective, such as worn or sticking piston rings and/or scored piston and cylinder.
6. Compression check is important because an engine with low or uneven compression cannot be tuned successfully to give peak performance. It is essential, therefore, that improper compression be corrected before proceeding with an engine tuneup.
7. Cylinder scoring: If powerhead shows any indication of overheating, such as discolored or scorched paint, visually inspect cylinders for scoring or other damage as outlined in Section 4 “Powerhead.”

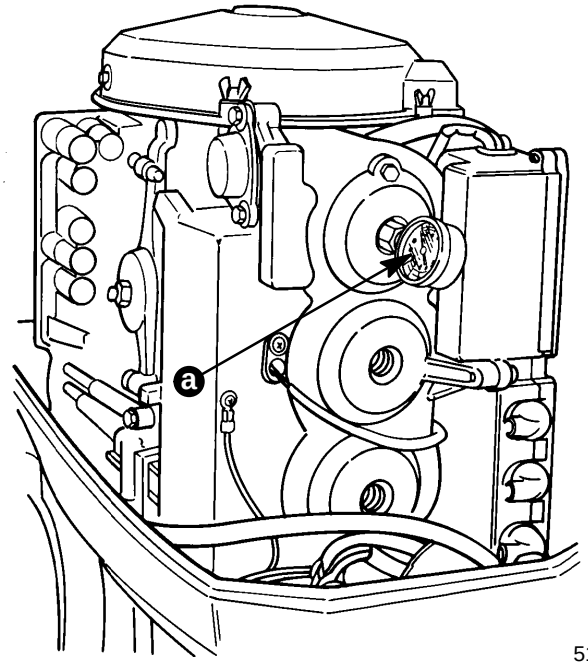
Water Pressure Check

NOTE: *To perform these checks, a Water Pressure Gauge Kit, P/N 91-79250A2 is recommended.*

1. Water pressure at idle, in neutral, is 1-3 psi (7-21 kPa).
2. Water pressure should increase, then drop to 4-6 psi (21-35 kPa) prior to 2500 RPM (due to poppet valve opening.)
3. At 2500 RPM, water pressure should not exceed 12 psi (83 kPa). Readings above 12 psi at 2500 RPM may indicate a stuck poppet valve.
4. Static test (boat stationary - operate in forward gear with a cut down “ smaller diameter” propeller) at 5000 RPM or above is 7-12 psi (48-83 kPa).

⚠CAUTION

A MODIFIED PROPELLER OR LOW PITCH PROPELLER IS REQUIRED TO PERFORM THE ABOVE STATIC TEST. STATIC TEST REQUIRES THE BOAT BE STATIONARY IN THE WATER SECURED TO A DOCK OR TRAILER AND RUN IN FORWARD GEAR. DO NOT USE A FLUSHING DEVICE FOR THIS TEST.

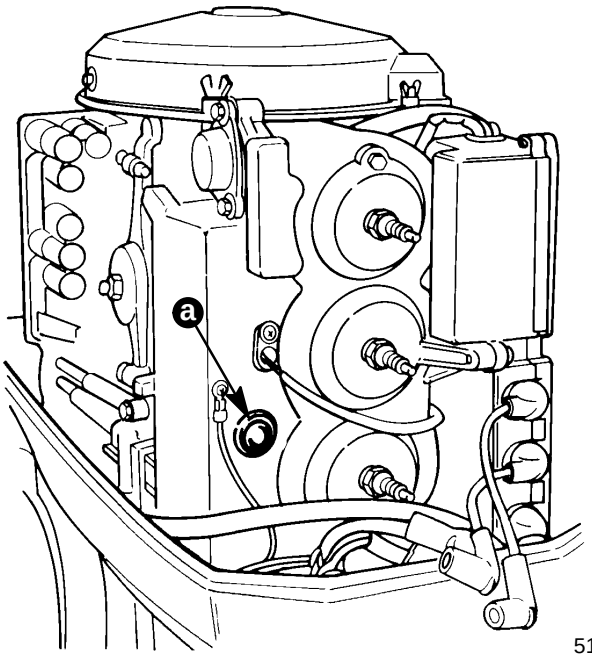


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a - Compression Gauge (P/N 91-29287)

Serial Number Location

The engine serial number is located on the starboard side of the swivel bracket (as on all Mariner/Mercury models) and also on the cylinder head (a).



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Painting Procedures

Cleaning & Painting Aluminum Propellers & Gear Housings

⚠ WARNING

Avoid serious injury from flying debris. Avoid serious injury from airborne particles. Use eye and breathing protection with proper ventilation.

PROPELLERS

1. Sand the entire area to be painted with 3M 120 Regalite Polycut or coarse Scotch-Brite, disc or belts.
2. Feather edges of all broken paint edges. Try not to sand through the primer.
3. Clean the surface to be painted using PPG Industries DX330 Wax and Grease Remover or equivalent (Xylene or M.E.K.).
4. If bare metal has been exposed, use Quicksilver's Light Gray Primer.
5. Allow a minimum of 1 hour dry time and no more than 1 week before applying the finish coat.
6. Apply the finish coat using Quicksilver's EDP Propeller Black.

GEAR HOUSINGS

The following procedures should be used in refinishing gear housings. This procedure will provide the most durable paint system available in the field. The materials recommended are of high quality and approximate marine requirements. The following procedure will provide a repaint job that compares with a properly applied factory paint finish. It is recommended that the listed materials be purchased from a local Ditzler Automotive Finish Supply Outlet. The minimum package quantity of each material shown following is sufficient to refinish several gear housings.

Procedure:

1. Wash gear housing with a muriatic acid base cleaner to remove any type of marine growth, and rinse with water, if necessary.
2. Wash gear housing with soap and water, then rinse.
3. Sand blistered area with 3M 180 grit sandpaper or P180 Gold Film Disc to remove paint blisters only. Feather edge all broken paint edges.
4. Clean gear housing thoroughly with (DX-330) wax and grease remover.
5. Spot repair surfaces where bare metal is exposed with (DX-503) alodine treatment.

IMPORTANT: Do not use any type of aerosol spray paints as the paint will not properly adhere to the surface nor will the coating be sufficiently thick to resist future paint blistering.

6. Mix epoxy chromate primer (DP-40) with equal part catalyst (DP-401) per manufacturers instructions, allowing proper induction period for permeation of the epoxy primer and catalyst.
7. Allow a minimum of one hour drying time and no more than one week before top coating assemblies.
8. Use Ditzler Urethane DU9000 for Mercury Black, DU34334 for Mariner Grey, and DU35466 for Force Charcoal, and DU33414M for Sea Ray White. Catalyze all three colors with Ditzler DU5 catalyst mixed 1:1 ratio. Reduce with solvents per Ditzler label.

⚠ CAUTION

Be sure to comply with instructions on the label for ventilation and respirators. Using a spray gun, apply one half to one mil even film thickness. Let dry, flash off for five minutes and apply another even coat of one half to one mil film thickness. This urethane paint will dry to the touch in a matter of hours, but will remain sensitive to scratches and abrasions for a few days.

9. The type of spray gun used will determine the proper reduction ratio of the paint.

IMPORTANT: Do not paint sacrificial zinc trim tab or zinc anode.

10. Cut out a cardboard "plug" for trim tab pocket to keep paint off of mating surface to maintain good continuity circuitry between trim tab and gear housing.

Decal Application

Decal Removal

1. Mark decal location before removal to assure proper alignment of new decal.
2. Carefully soften decal and decal adhesive with a heat gun or heat blower while removing old decal.
3. Clean decal contact area with a 1:1 mixture of isopropyl alcohol and water.
4. Thoroughly dry decal contact area and check for a completely cleaned surface.

Instructions for “Wet” Application

NOTE: *The following decal installation instructions are provided for a “Wet” installation.* ***All*** *decals should be applied wet.*

TOOLS REQUIRED

1. Plastic Squeegee*
2. Stick Pin
3. Dish Washing **Liquid/Detergent without ammonia**** “Joy” and “Drift” are known to be compatible for this process.

* Automotive Body Filler Squeegee

** Do not use a soap that contains petroleum based solvents.

SERVICE TIP: Placement of decals using the “Wet” application will allow time to position decal. Read entire installation instructions on this technique before proceeding.

TEMPERATURE

IMPORTANT: Installation of vinyl decals should not be attempted while in direct sunlight. Air and surface temperature should be between 60°F (15°C) and 100°F (38°C) for best application.

SURFACE PREPARATION

IMPORTANT: Do not use a soap or any petroleum based solvents to clean application surface.

Clean entire application surface with mild dish washing liquid and water. Rinse surface thoroughly with clean water.

DECAL APPLICATION

1. Mix $^{1}/_{2}$ ounce (16 ml) of dish washing liquid in one gallon (4 l) of cool water to use as wetting solution.

NOTE: *Leave protective masking, if present, on the face of decal until final steps of decal installation. This will ensure that the vinyl decal keeps it’s shape during installation.*

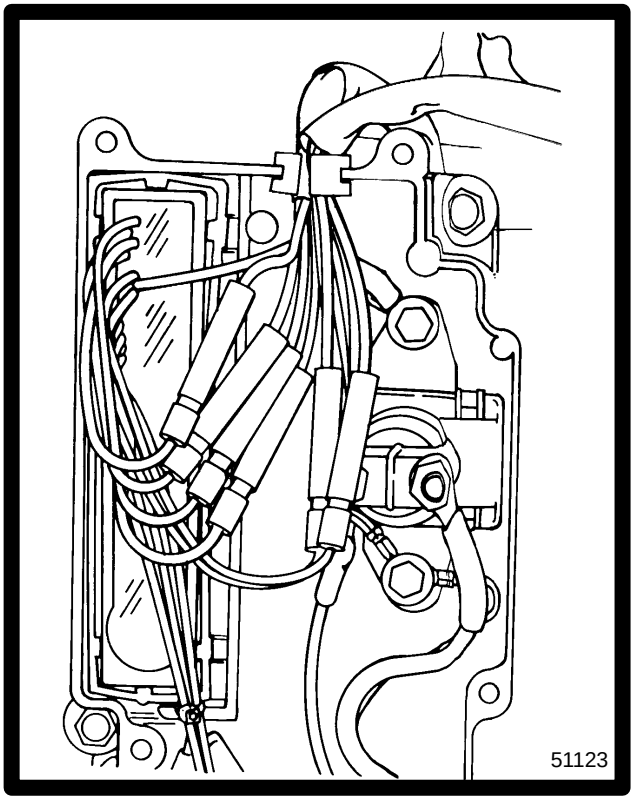
2. Place the decal face down on a clean work surface and remove the paper backing from “adhesive side” of decal.
3. Using a spray bottle, flood the entire “adhesive side” of the decal with the pre-mixed wetting solution.
4. Flood area where the decal will be positioned with wetting solution.
5. Position pre-wetted decal on wetted surface and slide into position.
6. Starting at the center of the decal, “**lightly**” squeegee out the air bubbles and wetting solution with overlapping strokes to the outer edge of the decal. Continue going over the decal surface until all wrinkles are gone and adhesive bonds to the cowl surface.
7. Wipe decal surface with soft paper towel or cloth.
8. **Wait 10 - 15 minutes.**
9. Starting at one corner, “carefully and slowly” pull the masking off the decal surface at a 180° angle.

NOTE: *To remove any remaining bubbles, pierce the decal at one end of the bubble with stick pin and press out the entrapped air or wetting solution with your thumb (moving toward the puncture).*

ELECTRICAL and IGNITION

2

A



IGNITION SYSTEM

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Description

The outboard ignition system is alternator-driven with distributor-less capacitor discharge. Major components of the ignition system are the flywheel, stator, trigger, switch box, ignition coils and spark plugs.

The stator assembly is mounted stationary below the flywheel and has 2 capacitor charging coils. The flywheel is fitted with permanent magnets inside the outer rim. As the flywheel rotates the permanent magnets pass the capacitor charging coils. This causes the capacitor charging coils to produce AC voltage. The AC voltage then is conducted to the switch box where it is rectified and stored in a capacitor.

The trigger assembly (also mounted under the flywheel) has 3 coils. The flywheel has a second set of permanent magnets (located around the center hub). As the flywheel rotates the second set of magnets pass the trigger coils. This causes the trigger coils to produce an AC voltage that is conducted to an electric Silicon Controlled Rectifier (SCR) in the switch box.

The switch discharges the capacitor voltage into the ignition coil at the correct time and firing order sequence.

Capacitor voltage is conducted to the primary side of the ignition coil. The ignition coil multiplies this voltage high enough to jump the gap at the spark plug.

The preceding sequence occurs once-per-engine-revolution for each cylinder.

Spark timing is changed (advanced/retarded) by rotating the trigger assembly which changes each trigger coil position in relation to the permanent magnets on the flywheel center hub.

IMPORTANT: If the engine misfires, runs rough or does not start, the ignition system should be checked using a Multi-Meter/DVA Tester (91-99750), or a voltmeter (capable of measuring 400 volts DC, or higher) and Direct Voltage Adaptor (91-89045).

Test Procedures

Direct Voltage Adapter (DVA) Tests

⚠ WARNING

DANGER – HIGH VOLTAGE/SHOCK HAZARD! Do not touch ignition components and/or metal test probes while engine is running and/or being “cranked”. STAY CLEAR OF SPARK PLUG LEADS. To assure personal safety, each individual spark plug lead should be grounded to engine.

⚠ CAUTION

To protect against meter and/or component damage, observe the following precautions:

- **400 VDC* test position (or higher) MUST BE used for all tests.**
- **INSURE the Positive (+) lead/terminal of DVA is connected to the Positive (+) receptacle of meter**
- **DO NOT CHANGE meter selector switch position while engine is running and/or being ”cranked”.**
- **Switch box MUST BE GROUNDED during tests. Running or ”cranking” engine with switch box ungrounded may damage switch box.**

*If using a meter with a built–in DVA, the DVA/400 VDC test position should be used.

NOTE: *Test leads are not supplied with the DVA. Use test leads supplied with meter.*

Test procedures and specifications are provided for **checking primary ignition voltage** while the engine is **running** and/or being **”cranked”.**

TROUBLESHOOTING TIPS:

1. Intermittent, weak, or no spark output at **two** spark plugs usually indicates a **bad TRIGGER.**
2. Intermittent, weak, or no spark output at all **three** spark plugs usually indicates a **bad STATOR** or **SWITCH BOX.**
3. Intermittent, weak, or no spark at any **one** spark plug usually indicates a bad **SPARK PLUG, COIL, or SWITCH BOX.**

Test Sequence

1-A) Check primary input voltage to coils (See Test Chart)

1. If voltage readings to coil(s) are **BELOW** specification, proceed with **Step 2-A.**
2. If voltage readings to coil(s) are **WITHIN** specifications, proceed with **Step 1-B.**

1-B) Check coils for spark. [Connect Spark Gap Tester (91–63998A1) between coil high voltage tower and spark plug.]

1. No spark or weak spark. **COIL** is bad.
2. Spark is OK, proceed with **Step 1-C.**

1-C) If Step 1-A and 1-B check OK, replace spark plugs.

If problem exists after replacing spark plugs, proceed with **Step 1-D.**

1-D) If Steps 1-A, 1-B, and 1-C check OK, check ignition timing.

1. If ignition timing **does not** check to specification (or a sudden or unexplained timing change occurs) check trigger advance linkage for loose and/or broken parts and check trigger magnet ring (on flywheel hub) for looseness and/or a shift in position.
2. If ignition checks to specification and engine does not run or runs poorly, **trouble exists with fuel system or engine mechanical.**

2-A) Check switch box "stop" circuit. (See Test Chart).

1. If reading is **BELOW** specifications, proceed with **Step 2-B.**
2. If reading is **ABOVE** specifications, the **Trigger** or **Switch Box** is bad (test trigger as outlined in this service manual section; if trigger checks OK, replace switch box and repeat check).
3. If reading is **WITHIN** specifications, proceed with **Step 3-A.**

2-B) Check ignition switch/wiring, as follows:

⚠ CAUTION

To prevent engine from starting, remove spark plug leads from ALL spark plugs and ground leads to engine.

1. Disconnect **ignition switch and stop switch** leads from switch box and isolate the leads.
2. Repeat check in **Step 2-A.**
   a. If reading is still **BELOW** specification, proceed with **Step 3-A.**
   b. If reading is **WITHIN** specification, **either the ignition switch, stop switch,** or **wiring** is bad.

3-A) Check stator low speed and high speed input to switch box. (see Test Chart).

1. If either the low speed or high speed reading to switch box is **BELOW** specification, **Stator** or **Switch Box** is bad (test stator as outlined in this service manual section; if stator checks to specification replace switch box and repeat check).
2. If both the low speed and high speed reading are **WITHIN** specification, replace switch box and repeat test.

Ignition System Test Chart

IMPORTANT: BEFORE attempting the ignition system checks, following, thoroughly read the preceding pages of these instructions to become familiar with the proper Automatic Distributorless Ignition (ADI) test sequence and procedures (particularly any "Safety Warnings" and "Cautions"). ALL tests are performed with lead wires connected – terminals exposed. SWITCH BOX MUST BE GROUNDED (CASE TO ENGINE BLOCK) FOR ALL TESTS – IF NOT, SWITCH BOXES MAY BE DAMAGED.

55/60 MARATHON/SEAPRO – (398-9873A-5 printed on the stator)
USA S/N 0G277479 and BELOW
BELGIUM S/N (Not Available at Time of Printing)

45 JET, 50/60 ELECTRIC – (398-9710A22, 398-9710A23, or 398-9710A34 printed on the stator)
USA S/N 0G277605 and BELOW
BELGIUM S/N (Not Available at Time of Printing)

NOTE: *When servicing a unit prior to the listed serial number and below, it is recommended that the flywheel be removed and the stator part number verified to determine proper testing applications.*

ADI Test Seq.	Test	Selector Sw. Position	DVA Leads		Voltage (1) @300-1000 RPM	Voltage @1000-4000 RPM
			Red	Black		
1–A	Coil Primary	400 VDC*	Coil (+) Terminal	Coil (–) Terminal	150–250	180–280
2–A	Switch Box - Stop Circuit	400VDC*	Black/Yellow(3) Sw. Box Terminal	Ground	200–360	200–360
3–A 4–A	Stator - Low Speed	400VDC*	Blue Sw. Box Terminal	Ground	200–300	200–330
3–A 4–A	Stator - High Speed	400VDC*	Red Sw. Box Terminal	Ground	20–90	130–300
5–A	Switch Box - Bias	20 VDC or 40 VDC	Ground (1)	White/Black Sw. Box Terminal (1)	2–10	10–30

(1) Using meter only, REVERSE LEAD POLARITY, connect leads as specified.
(*) If using a meter with built-in DVA, place selector switch in the DVA/400 VDC position.

55/60 MARATHON/SEAPRO – (398-9873A21 printed on the stator)
USA S/N 0G277480 and ABOVE
BELGIUM S/N (Not Available at Time of Printing)

45 JET, 50/60 ELECTRIC – (398-9873A24 printed on the stator)
USA S/N 0G277606 and ABOVE
BELGIUM S/N (Not Available at Time of Printing)

ADI Test Seq.	Test	Selector Sw. Position	DVA Leads		Voltage @300 RPM	Voltage @1000 RPM	Voltage @4000 RPM
			Red	Black			
1–A	Coil Primary	400 VDC*	Coil (+) Terminal	Coil (–) Terminal	145–175	210–250	200–240
2–A	Switch Box - Stop Circuit	400VDC*	Black/Yellow(3) Sw. Box Terminal	Ground	215–265	280–340	260–320
3–A 4–A	Stator - Low Speed	400VDC*	Blue Sw. Box Terminal	Ground	215–265	280–340	260–320
3–A 4–A	Stator - High Speed	400VDC*	Red Sw. Box Terminal	Ground	10–15	45–55	205–255
5–A	Switch Box - Bias	20 VDC or 40 VDC	Ground (1)	White/Black Sw. Box Terminal (1)	2–10	10–30	10–30

(1) Using meter only, REVERSE LEAD POLARITY, connect leads as specified.
(*) If using a meter with built-in DVA, place selector switch in the DVA/400 VDC position.

⚠ WARNING

When testing or servicing the ignition system, high voltage is present, be extremely cautious! DO NOT TOUCH OR DISCONNECT any ignition parts while engine is running, while key switch is on, or while battery cables are connected.

⚠ CAUTION

Failure to comply with the following items may result in damage to the ignition system.

1. **DO NOT reverse battery cable connections. The battery negative cable is (-) ground.**
2. **DO NOT "spark" battery terminals with battery cable connections to check polarity.**
3. **DO NOT disconnect battery cables while engine is running.**
4. **DO NOT crank engine when switch box is not grounded to engine.**

A process of elimination must be used when checking the ignition system without a Multi-Meter/DVA Tester (91-99750) or a voltmeter (capable of measuring 400 volts DC, or higher) and Direct Voltage Adaptor (91-89045), as the switch box and ignition coils cannot be thoroughly checked with conventional test equipment.

All other components can be tested with an ohmmeter. Before troubleshooting the ignition system, check the following:

1. Make sure that electrical harness and ignition switch are not the source of the problem.
2. Check that plug-in connectors are fully engaged and terminals are free of corrosion.
3. Make sure that wire connections are tight and free of corrosion.
4. Check all electrical components, that are grounded directly to engine, and all ground wires to see that they are grounded to engine.
5. Check for disconnected wires, and short and open circuits.

STATOR TEST

NOTE: *Stator can be tested without removing from engine.*

1. Disconnect stator leads from switch box.
2. Use an ohmmeter and perform the following tests.

IMPORTANT: If stator is mounted on engine, black stator lead must be grounded to powerhead when testing. Connect test lead to black stator lead if stator is removed from engine.

NOTE: *Readings are for a cold engine (room temperature). Resistance will increase slightly, if engine is warm.*

3. If meter readings are other than specified, replace stator assembly.

55/60 MARATHON/SEAPRO – (398-9873A-5 printed on the stator)
USA S/N 0G277479 and BELOW
BELGIUM S/N (Not Available at Time of Printing)

45 JET, 50/60 ELECTRIC – (398-9710A22, 398-9710A23, or 398-9710A34 printed on the stator)
USA S/N 0G277605 and BELOW
BELGIUM S/N (Not Available at Time of Printing)

NOTE: *When servicing a unit listed "Serial Number and Below", it is recommended that the flywheel be removed and the stator part number verified to determine proper testing applications.*

Test Leads	Resistance (OHMS)	Scale Reading (x_____)
Between Blue Stator Lead and Red Stator Lead (Low Speed)	3600 – 4200 (90 – 140)	3.6 – 4.2 (R x 1000)
Between Red Stator Lead and Engine Ground* (Hi-Speed)	90 – 140	90 – 140 (R x 1)

*If stator is mounted on engine, black stator lead must be grounded to powerhead when testing. Connect test lead to black stator lead if stator is removed from engine.

55/60 MARATHON/SEAPRO – (398-9873A21 printed on the stator)
USA S/N 0G277480 and ABOVE
BELGIUM S/N (Not Available at Time of Printing)

45 JET, 50/60 ELECTRIC – (398-9873A24 printed on the stator)
USA S/N 0G277606 and ABOVE
BELGIUM S/N (Not Available at Time of Printing)

Test Leads	Resistance (OHMS)	Scale Reading (x_____)
Between Blue Stator Lead and Red Stator Lead (Low Speed)	1100 – 1600	1.1 – 1.6 (R x 1000)
Between Red Stator Lead and Engine Ground* (Hi-Speed)	30 – 35	30 – 35 (R x 1)

*If stator is mounted on engine, black stator lead must be grounded to powerhead when testing. Connect test lead to black stator lead if stator is removed from engine.

IGNITION COIL TEST

IMPORTANT: Ohmmeter tests can only detect certain faults in the ignition coil. Replace ignition coil, if ohmmeter readings (listed in chart, following) are not as specified. If coil tests OK, and coil is still suspected of being faulty, use Multi-Meter/DVA Tester (91-99750) or a voltmeter (capable of measuring 400 volts DC, or higher) and Direct Voltage Adaptor (91-89045) to thoroughly check coil.

1. Disconnect wires from coil terminals.
2. Pull spark plug lead out of coil tower.
3. Use an ohmmeter and perform the following tests.

Test Leads	Resistance (OHMS)	Scale Reading (x_____)
Between (+) and (-) Coil Terminals	.02-.04*	.02-.04* (R x 1)
Between Coil Tower and (-) Coil Terminal	800-1100**	8-11** (R x 100)

* The primary DC resistance of these coils generally is less than one (1) OHM. If a reading resembling a short is obtained, this would be acceptable.

** Copper wire is an excellent conductor, but it will have a noticeable difference in resistance from cold to hot temperatures. Reasonable variations from these readings are acceptable.

4. If meter readings are not as specified, replace ignition coil.

TRIGGER TEST

1. Disconnect all trigger leads from switch box.
2. Use an Ohmmeter and perform the following tests.

Test Leads	Resistance (OHMS)	Scale Reading (x_____)
Between Brown Trigger Lead and White/Black Trigger Lead	1100-1400	11-14 (R x 100)
Between White Trigger Lead and White/Black Trigger Lead	1100-1400	11-14 (R x 100)
Between Violet Trigger Lead and White/Black Trigger Lead	1100-1400	11-14 (R x 100)

NOTE: *Above readings are for a cold engine (room temperature). Resistance will increase slightly, if engine is warm.*

3. If meter readings are not as specified, replace trigger.

ADI Ignition using a RED Stator with an Adapter Module

Red stators require an adapter module that is connected between the stator and switch box. Without the adapter module, the voltage supplied by the stator would exceed the voltage capability of the switch box.

RED Stator with Adaptor and Ignition Coils

RED Stator DVA Test

NOTE: *If using a meter with a built -in DVA, place selector switch in the DVA/400 VDC position.*

NOTE: *Red stators require an adapter module that is connected between the stator and switch box. Without the adapter module, the voltage supplied by the stator would exceed the voltage capability of the switch box.*

Test	Selector Switch Position	RED DVA Lead	BLACK DVA Lead	Voltage @ 300 RPM	Voltage @ 1000 RPM	Voltage @ 4000 RPM
Coil Primary	400 VDC*	Coil (+) Terminal	Coil (–) Terminal	130 Volts Minimum	195 to 275	195 to 275
Stop Circuit	400 VDC*	Black/Yellow Sw. Box Terminal	Ground	190 Volts Minimum	275 to 320	260 to 320
Blue Sw. Box Terminal	400 VDC*	Blue Sw. Box Terminal	Ground	190 Volts Minimum	275 to 320	260 to 320
Blue/White Sw. Box Terminal	400 VDC*	Blue/White Sw. Box Terminal	Ground	190 Volts Minimum	275 to 320	260 to 320

NOTE: *The stator for manual start engines have a BLUE/WHITE and a BLACK wire which provide power for the overheat horn and overspeed limiter module.*

NOTE: *Resistance varies greatly with temperature. Measurements should be made within an ambient range of 65 to 85 degrees F°*

Electric Start Engines

Red Stator Resistance Test (all wires disconnected)		R x 1 Ohms Scale
Positive Meter Lead (+)	**Negative Meter Lead (–)**	
Connect to White/Green stator lead	Connect to Green/White stator lead	660 – 710
Connect to Yellow stator lead	Connect to Yellow stator lead	0.165 – 0.181

Manual Start Engines

Red Stator Resistance Test (all wires disconnected)		R x 1 Ohms Scale
Positive Meter Lead (+)	**Negative Meter Lead (–)**	
Connect to White/Green stator lead	Connect to Green/White stator lead	660 – 710
Connect to Blue/White	Connect to Black	130 – 145
Connect to Yellow stator lead	Connect to Yellow stator lead	0.17 – 0.19

Troubleshooting Procedures

If the DVA reading is **HIGH** (particularly @ 1000 RPM) the ADAPTER MODULE is defective.

If the DVA reading is **LOW**, the stator, adapter module or switch box may be defective. Refer to the particular engine model procedure, following, to isolate the problem.

- Disconnect the BLUE adapter lead from the switch box.
- Connect the DVA meter between the BLUE adapter lead and ground.
- Crank the engine (manual or electric).
- If the DVA is normal (190 to 260 volts), the **switch box is defective**.
- If the DVA reading is still low, either the stator or the adapter is defective.
- Disconnect the GREEN/WHITE and WHITE/GREEN stator leads from the adapter.
- Measure the resistance between the GREEN/WHITE and WHITE/GREEN stator leads.
- If the resistance is normal (660 to 710 ohms), the **adapter is defective**.
- If the resistance is incorrect, the **stator is defective**.

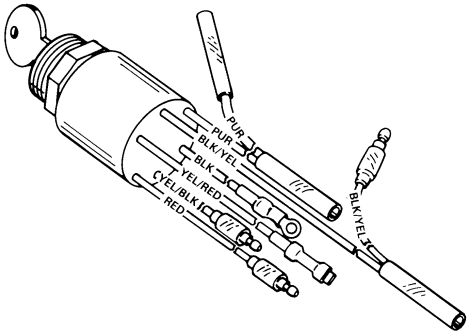
Ignition (Key) Switch Test

1. Disconnect remote control wiring harness and instrument panel connector.

NOTE: *Wiring diagram for control boxes is located in SECTION 2D.*

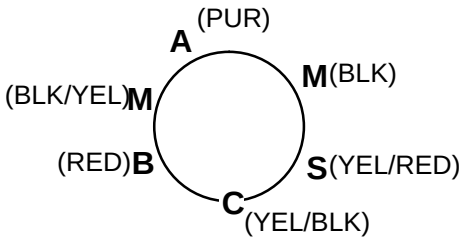
2. Set ohmmeter on R x 1 scale for the following tests:

COMMANDER 2000 KEY SWITCH



23894

COMMANDER KEY SWITCH



KEY POSITION	CONTINUITY SHOULD BE INDICATED AT THE FOLLOWING POINTS:					
	BLK	BLK/YEL	RED	YEL/RED	PUR	YEL/BLK
OFF	• -	- - -•				
RUN			•- - - - - - - -		- -•	
START			•- - - -			
				•- - - -		
			•- - - - - - - -		- -•	
CHOKE*			•- - - - - - -		- - - - - -	
			•- - - - - - - -		- -•	
					•- - - -	

*Key switch must be positioned to “RUN” or “START” and key pushed in to actuate choke, for this continuity test.

BLK•BLACK
PUR•PURPLE
RED•RED
YEL•YELLOW

3. If meter readings are other than specified in the preceding test, verify that switch and not wiring is faulty. If wiring checks OK, replace switch.

Ignition Components Removal and Installation

Flywheel

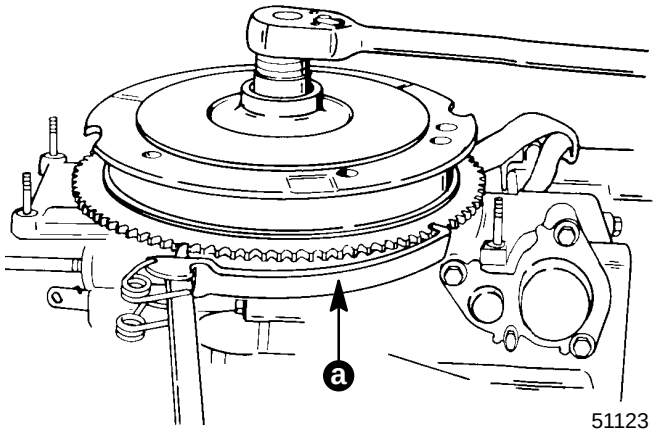
REMOVAL

1. Remove flywheel cover from engine.

⚠ WARNING

Engine could possibly start when turning flywheel during removal and installation; therefore, disconnect (and isolate) spark plug leads from spark plugs to prevent engine from starting.

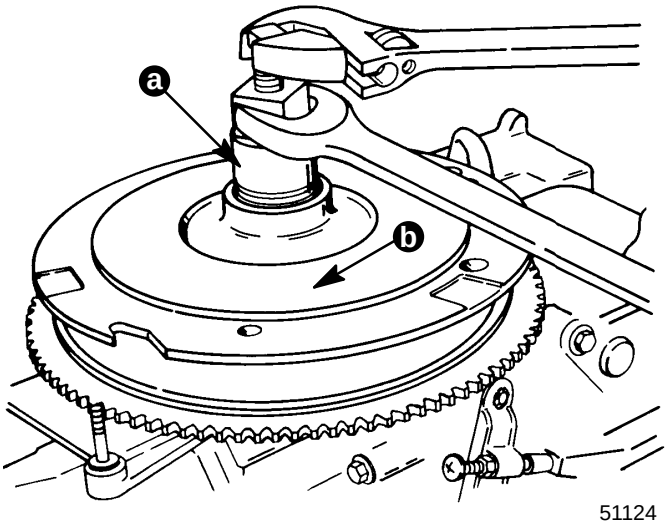
2. Disconnect spark plug leads from spark plugs.
3. While holding flywheel with Flywheel Holder (a) (91-52344), remove flywheel nut and washer.



51123

4. Install Crankshaft Protector Cap (91-24161) on the end of crankshaft, then install Flywheel Puller (a) (91-73687A1) into flywheel (b).
5. Remove flywheel.

NOTE: *Neither heat or hammer should be used on flywheel to aid in removal as damage to flywheel or electrical components under flywheel may result.*



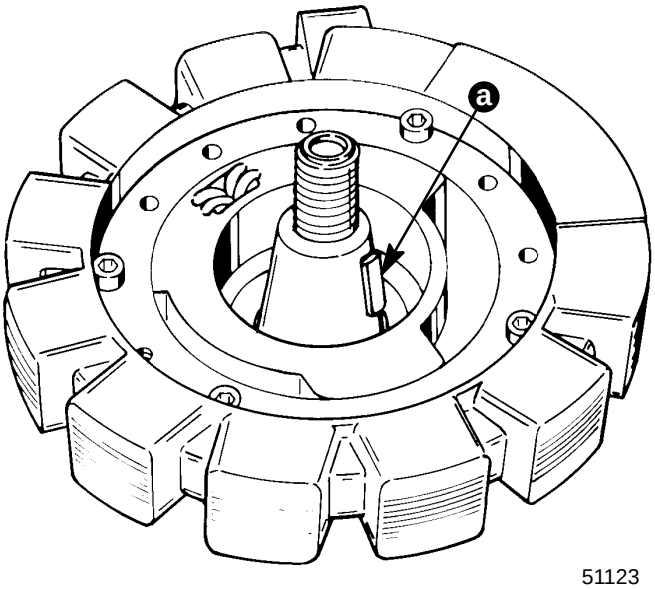
51124

INSTALLATION

⚠ WARNING

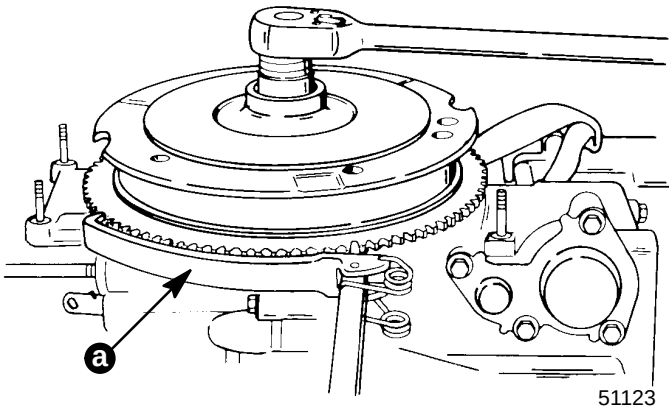
Engine could possibly start when turning flywheel during installation; therefore, disconnect (and isolate) spark plug leads from spark plugs to prevent engine from starting.

1. Disconnect spark plug leads from spark plugs.
2. Place flywheel key (a) into slot in crankshaft.



51123

3. Align slot in flywheel center bore with flywheel key and install flywheel onto crankshaft.
4. Install washer and locknut.
5. Hold flywheel with Flywheel Holder (a) (91-52344); torque locknut to 100 lb. ft. (136 N·m).



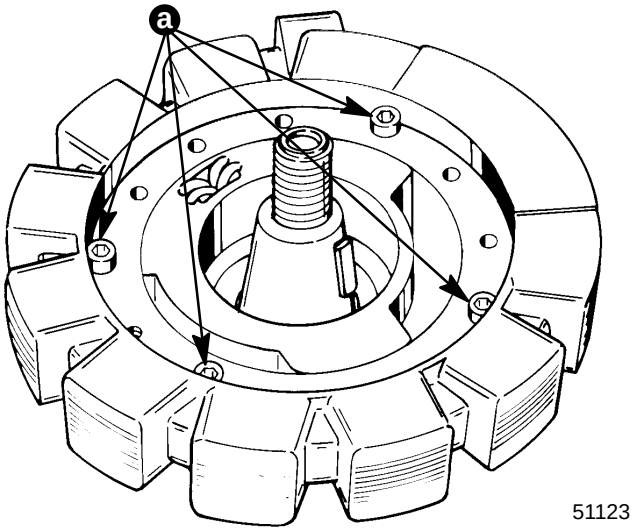
51123

6. Install flywheel cover.

BLACK and RED Stator

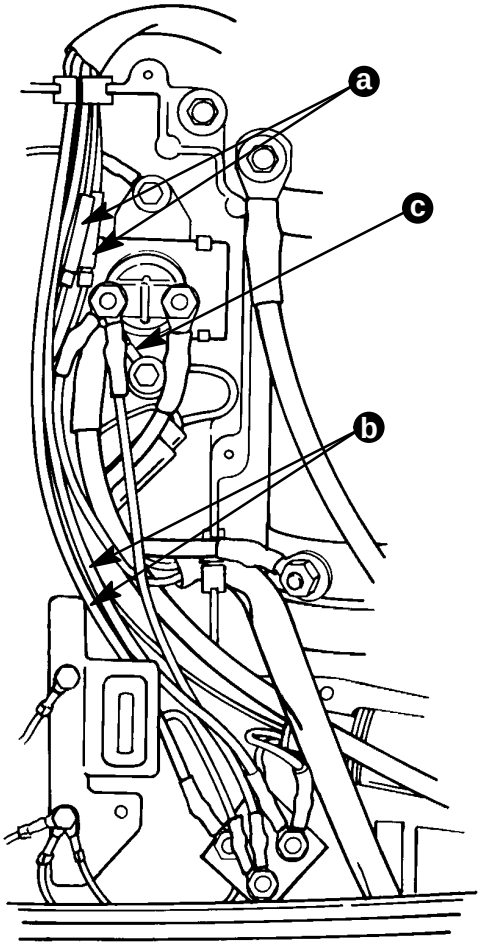
REMOVAL

1. Remove flywheel; refer to “Flywheel Removal”.
2. Remove screws (a).



51123

3. Disconnect stator leads as shown and remove stator.

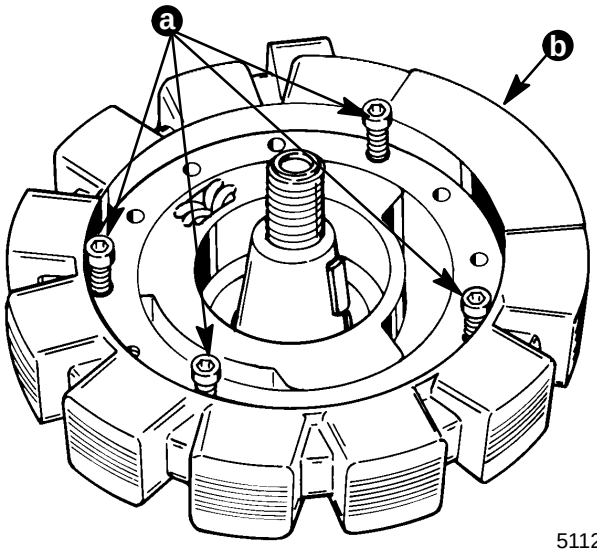


51124

a - Stator Leads to Switch Box (2)
b - Yellow Leads to Rectifier (2)
c - Ground Lead (1)

BLACK STATOR INSTALLATION

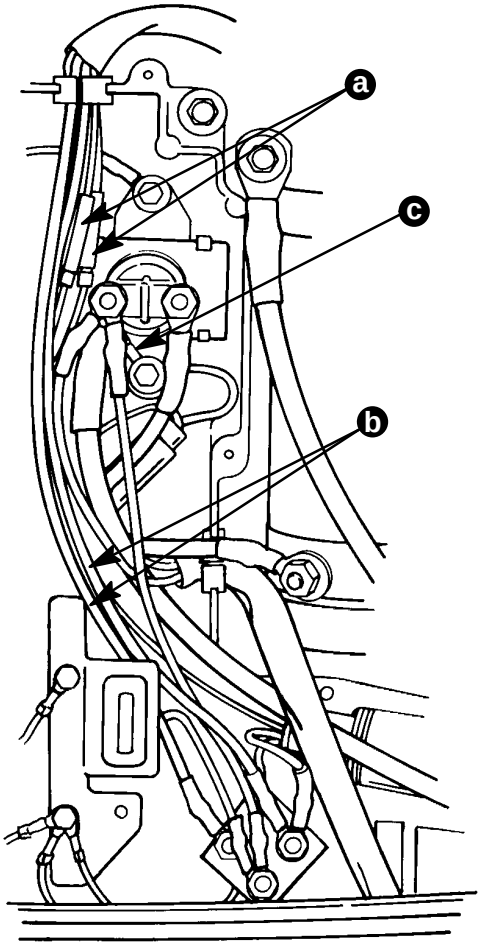
1. Install stator as shown.



51124

a - Screws; apply Loctite 271 on Threads (unless Patch Screw used) and torque to 60 lbs. in. (7.0 N·m)
b - Stator

2. Connect stator leads; refer to wiring diagrams in Section 2D.



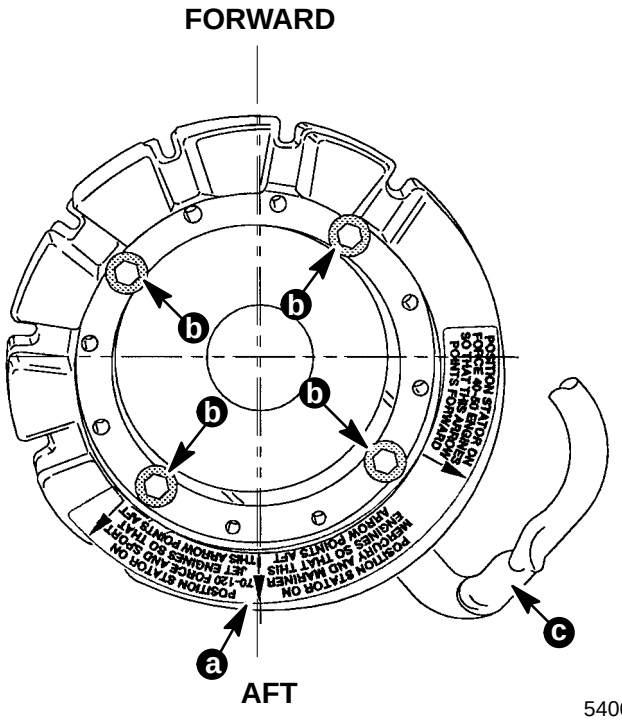
51124

a - Stator Leads to Switch Box (2)
b - Yellow Leads to Rectifier (2)
c - Ground Lead (1)

RED STATOR INSTALLATION

IMPORTANT: The stator must be oriented as shown to obtain correct system voltage.

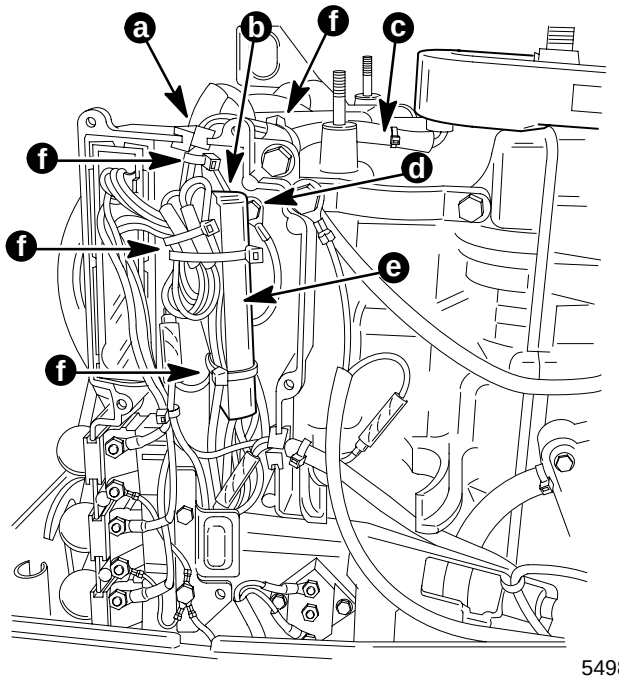
1. Position red stator so appropriate arrow on decal points aft.
2. Secure stator with four (4) attaching screws retained from disassembly. Apply Loctite 222 to threads and torque to 60 lb. in. (7.0 N·m).



54067

a - Orient Appropriate Arrow of Decal Aft
b - Apply Loctite 222 (obtain locally) To Screws (4) and Torque to 60 lb. in. (7.0 N·m)
c - Stator Harness

3. Route stator harness thru top of electrical plate grommet as shown. Secure to powerhead with sta-strap.
4. Position stator adaptor in cavity of electrical plate with blue lead toward top of engine.
5. Refer to electrical diagram and make electrical connections as shown.
6. Bundle and secure stator adaptor, harnesses and connections with sta-straps as shown.



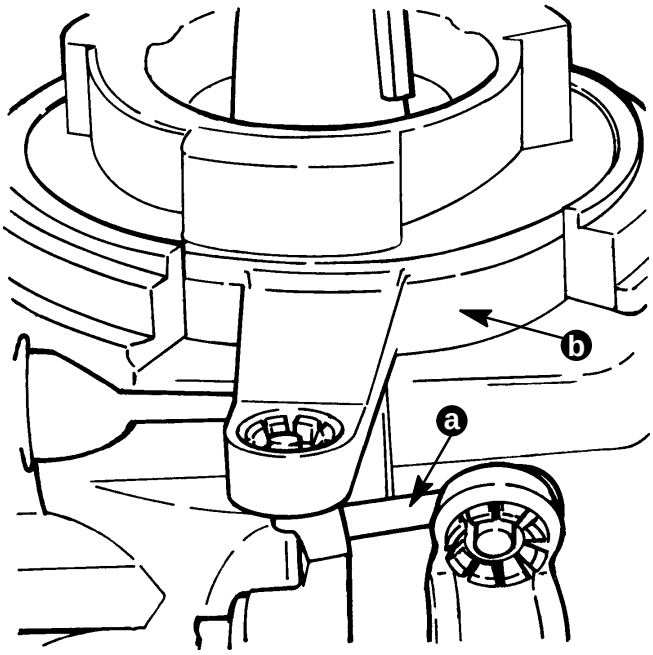
54981

a - Electrical Plate Grommet
b - Blue Lead of Stator Adaptor
c - Stator Harness
d - Black Ground Lead of Stator Adaptor
e - Stator Adaptor
f - Sta-Straps

Trigger

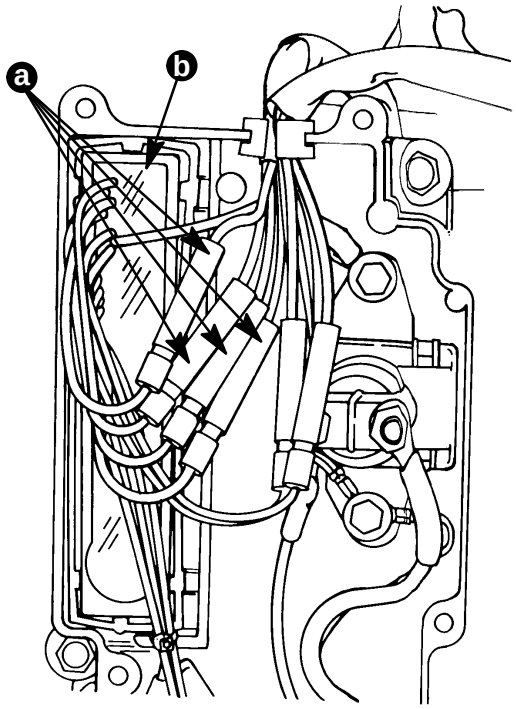
REMOVAL

1. Remove flywheel and stator; refer to “Flywheel” and “Stator” removal, preceding.
2. Disconnect link arm (a) and remove trigger(b).



19459

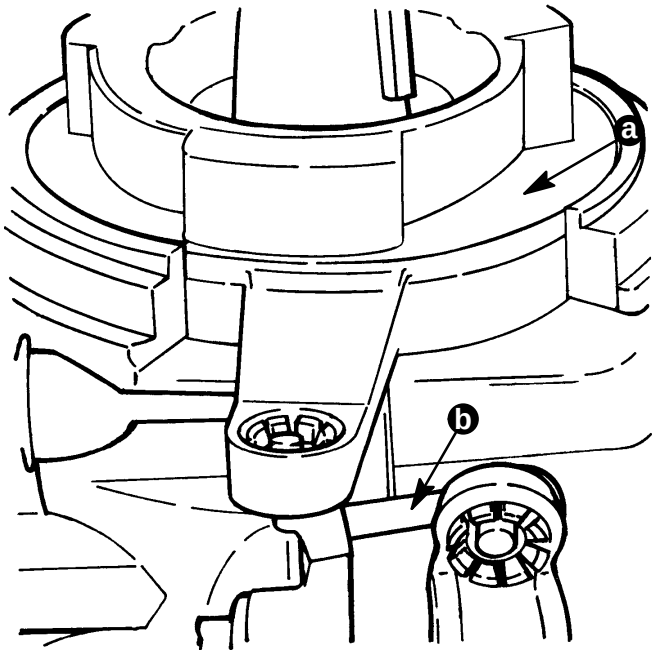
3. Disconnect trigger leads (a) from switch box (b) and remove trigger.



51123

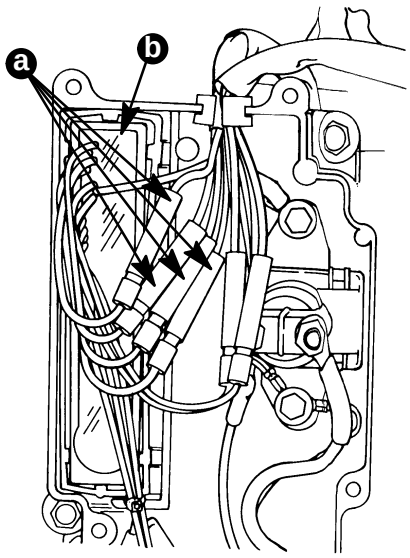
INSTALLATION

1. Install trigger (a) and connect link arm (b).



19459

2. Connect trigger leads (a) to switch box (b); refer to wiring diagrams in Section 2D.

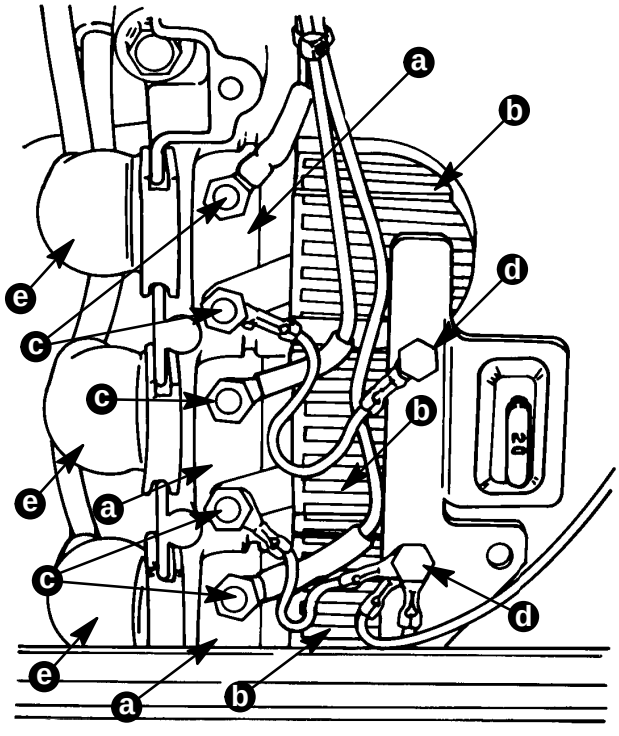


51123

3. Install stator; refer to “Stator Installation”, preceding.
4. Install flywheel; refer to “Flywheel Installation”, preceding.

Ignition Coils

1. Refer to wiring diagrams in Section 2D when connecting wires.

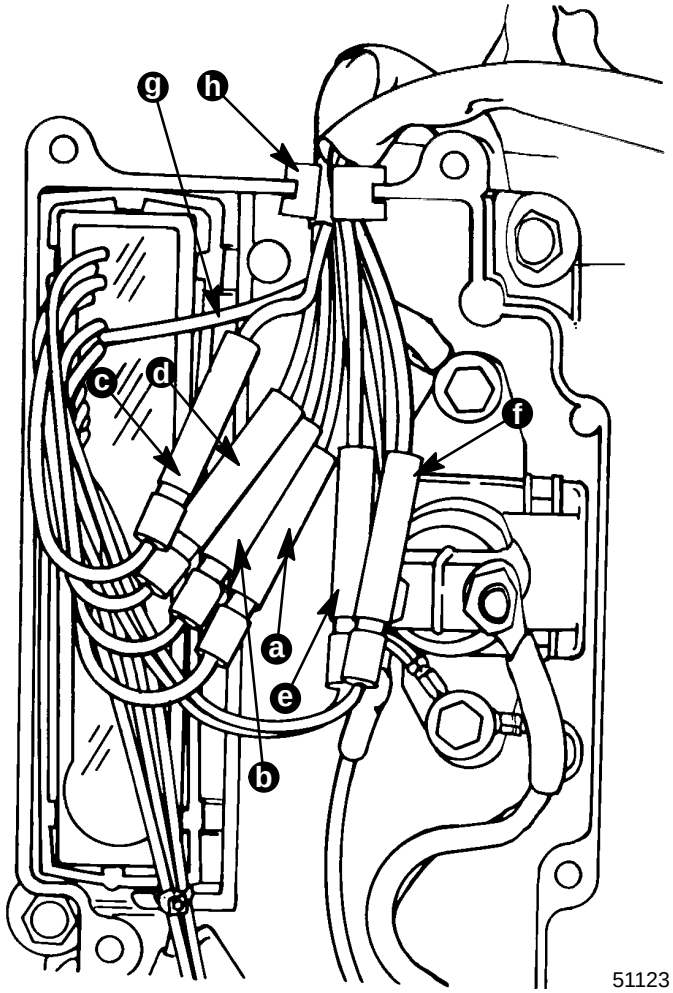


51124

a - Coils
b - Cover
c - Hex Nuts; coat with Quicksilver Liquid Neoprene
d - Bolts; torque to 20 lb. in. (2.5 N·m)
e - Coil Tower Boots; form a water tight seal between coil tower and spark plug lead using Quicksilver Insulating Compound

Switch Box

1. Refer to wiring diagrams in Section 2D when connecting wires.



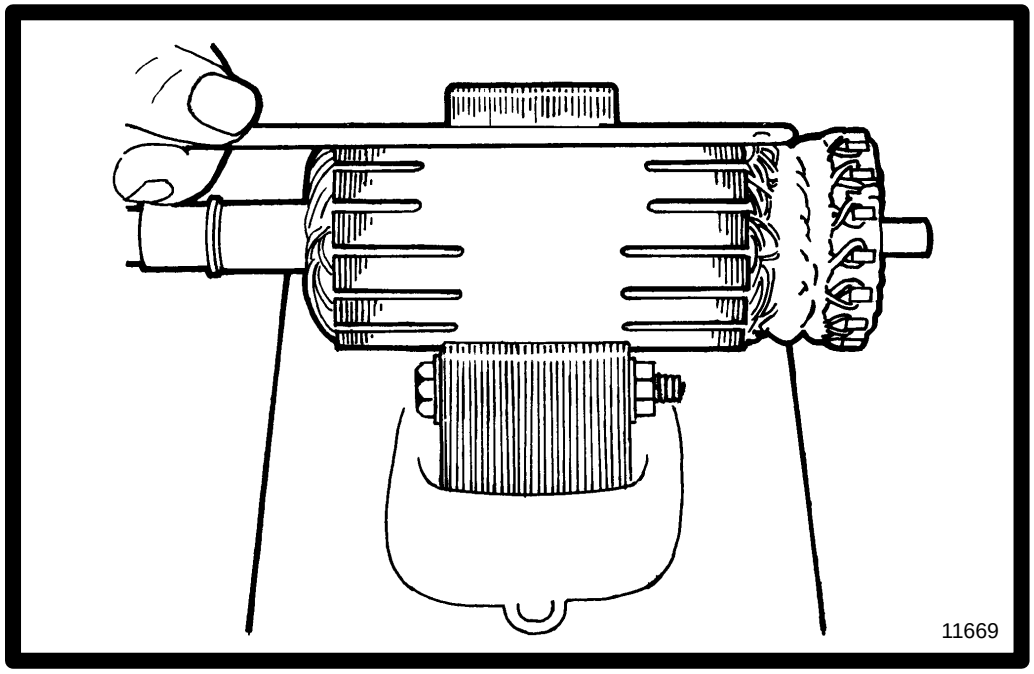
51123

a - White/Black
b - Purple
c - Brown
d - White
e - Red
f - Blue
g - Black
h - Grommet

ELECTRICAL

2

B



BATTERY, CHARGING SYSTEM and STARTING SYSTEM

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Battery

Precautions

When charging batteries, an explosive gas mixture forms in each cell. A portion of this gas escapes thru holes in vent plugs and may form an explosive atmosphere around battery if ventilation is poor. This explosive gas may remain in or around battery for several hours after it has been charged. Sparks or flames can ignite this gas and cause an internal explosion which may shatter the battery.

The following precautions should be observed to prevent an explosion.

1. DO NOT smoke near batteries being charged or which have been charged very recently.
2. DO NOT break live circuits at terminals of batteries because a spark usually occurs at the point where a live circuit is broken. Always be careful when connecting or disconnecting cable clamps on chargers. Poor connections are a common cause of electrical arcs which cause explosions.
3. DO NOT reverse polarity of battery cables on battery terminals.

⚠ CAUTION

If battery acid comes into contact with skin or eyes, wash skin immediately with a mild soap. Flush eyes with water immediately and see a doctor.

Recommended Battery

The 2-cycle Outboard type engine requires a 12 volt battery with a “Cold Cranking Amperage” rating for cranking and a “Reserve Capacity” rating. The minimum should be a “Cold Cranking Amperage” of 350 amperes and a “Reserve Capacity” of 100 minutes for engines outlined in this manual.

Operating Engine Without Battery

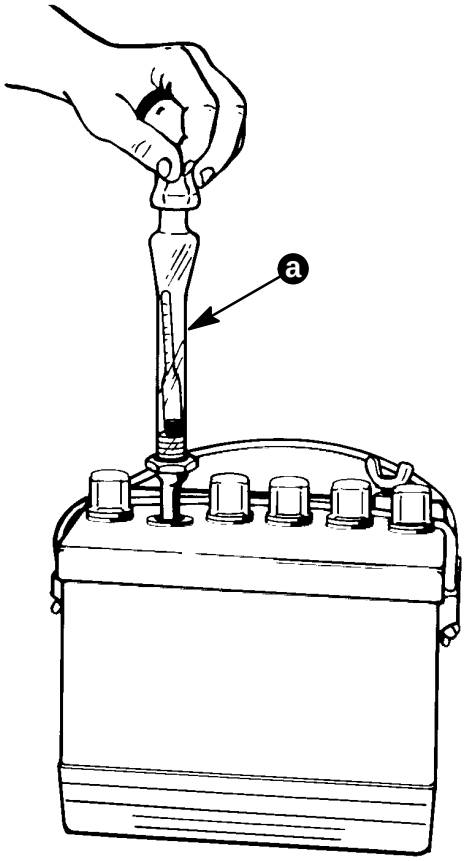
If desired (or in an emergency), engines equipped with an alternator can be started and operated without a battery (either disconnected or removed) if “Warning”, below, is followed.

⚠ WARNING

Before operating engine with battery leads disconnected from battery, disconnect stator leads (yellow) from rectifier. Insulate (tape) stator lead ring terminals.

Specific Gravity Readings

Use a hydrometer (a) to measure specific gravity of electrolyte in each cell.



22532

Hydrometer measures percentage of sulfuric acid in battery electrolyte in terms of specific gravity. As a battery drops from a charged to a discharged condition, acid leaves the solution and chemically combines with the plates, causing a decrease in specific gravity of electrolyte. An indication of concentration of electrolyte is obtained with a hydrometer.

When using a hydrometer, observe the following points:

1. Hydrometer must be clean (inside and out) to insure an accurate reading.
2. Never take hydrometer readings immediately after water has been added. Water must be thoroughly mixed with electrolyte by charging for at least 15 minutes at a rate high enough to cause vigorous gassing.
3. If hydrometer has built-in thermometer, draw liquid in several times to ensure correct temperature before taking reading.
4. Hold hydrometer vertically and draw in just enough liquid from battery cell so that float is free-floating. Hold hydrometer at eye level so that float is vertical and free of outer tube, then take reading at surface of liquid. Disregard curvature where liquid rises against float stem due to capillary action.
5. Avoid dropping electrolyte on boat or clothing, as it is extremely corrosive. Wash off immediately with baking soda solution.

Specific gravity of electrolyte varies not only with percentage of acid in liquid but also with temperature.As temperature drops, electrolyte contracts, so that specific gravity increases. Unless these variations in specific gravity are taken into account, specific gravity obtained by hydrometer may not give a true indication of concentration of acid in electrolyte.

A fully charged battery will have a specific gravity reading of approximately 1.270 at an electrolyte temperature of 80° F (27° C). If electrolyte temperature is above or below 80° F, additions or subtractions must be made in order to obtain a hydrometer reading corrected to 80° F standard. For every 10° F (3.3° C) above 80° F, add 4 specific gravity points (.004) to hydrometer reading. Example: A hydrometer reading of 1.260 at 110° F (43° C) would be 1.272 corrected to 80° F, indicating a fully charged battery.

For every 10° below 80° F, subtract 4 points (.004) from the reading. Example: A hydrometer reading of 1.272 at 0° F (-18° C) would be 1.240 corrected to 80° F, indicating a partially charged battery.

SPECIFIC GRAVITY CELL COMPARISON TEST

This test may be used when an instrumental tester is not available. To perform this test, measure specific gravity of each cell, regardless of state of charge, and interpret results as follows: If specific gravity readings show a difference between highest and lowest cell of .050 (50 points) or more, battery is defective and should be replaced.

Electrolyte Level

Check electrolyte level in battery regularly. A battery in use in hot weather should be checked more frequently because of more rapid loss of water. If electrolyte level is found to be low, then distilled water should be added to each cell until liquid level rises approximately 3/16” (4.8mm) over plate. DO NOT OVERFILL, because this will cause loss of electrolyte and result in poor performance, short life and excessive corrosion.

⚠CAUTION

During service, only distilled water should be added to the battery, not electrolyte.

Charging A Discharged Battery

The following basic rules apply to any battery charging situation:

1. Any battery may be charged at any rate (in amperes) as long as spilling of electrolyte (from violent gassing) does not occur and as long as electrolyte temperature does not exceed 125° F (52° C). If spewing of electrolyte occurs, or if electrolyte temperature exceeds 125° F, charging rate (in amperes) must be reduced or temporarily halted to avoid damage to the battery.
2. Battery is fully charged when, over a 2-hour period at a low charging rate (in amperes), all cells are gassing freely (not spewing liquid electrolyte), and no change in specific gravity occurs. Full charge specific gravity is 1.260-1.275, corrected for electrolyte temperature with electrolyte level at 3/16” (4.8mm) over plate. For most satisfactory charging, lower charging rates in amperes are recommended.
3. If, after prolonged charging, specific gravity of at least 1.230 on all cells cannot be reached, battery is not in optimum condition and will not provide optimum performance; however, it may continue to provide additional service, if it has performed satisfactorily in the past.
4. To check battery voltage while cranking engine with electric starter motor, place red (+) lead of tester on positive (+) battery terminal and black (-) lead of tester on negative (-) battery terminal. If the voltage drops below 9-1/2 volts while cranking, the battery is weak and should be recharged or replaced.

Winter Storage of Batteries

Battery companies are not responsible for battery damage, either in winter storage or in dealer stock, if the following instructions are not observed:

1. Remove battery from its installation as soon as possible and remove all grease, sulfate and dirt from top surface by running water over top of battery. Be sure, however, that vent caps are tight beforehand, and blow off all excess water thoroughly with compressed air. Check water level, making sure that plates are covered.
2. When adding distilled water to battery, be extremely careful not to fill more than 3/16" (4.8mm) over plate inside battery. Battery solution or electrolyte expands from heat caused by charging. Overfilling battery will cause electrolyte to overflow (if filled beyond 3/16" over plate).
3. Grease terminal bolts well with Quicksilver 2-4-C Marine Lubricant, and store battery in COOL-DRY place. Remove battery from storage every 30-45 days, check water level (add water if necessary), and put on charge for 5 or 6 hours at 6 amperes. DO NOT FAST CHARGE.
4. If specific gravity drops below 1.240, check battery for reason, and then recharge. When gravity reaches 1.260, discontinue charging. To check specific gravity, use a hydrometer, which can be purchased locally.
5. Repeat preceding charging procedure every 30-45 days, as long as battery is in storage. When ready to place battery back in service, remove excess grease from terminals (a small amount is desirable on terminals at all times), recharge again as necessary and reinstall battery.

⚠ WARNING

Hydrogen and oxygen gases are produced during normal battery operation or charging. Sparks or flame can cause this mixture to ignite and explode, if they are brought near the battery. Sulfuric acid in battery can cause serious burns, if spilled on skin or in eyes. Flush or wash away immediately with clear water.

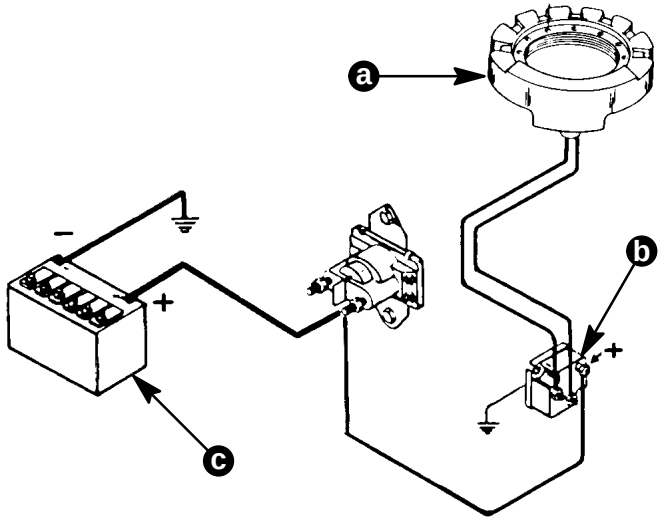
Battery Charging System

Description

The battery charging system components are the stator, rectifier or voltage regulator/rectifier and the battery. Alternating current is generated in the stator alternator coils and flows to the rectifier. The rectifier changes the alternating current to direct current for charging the battery.

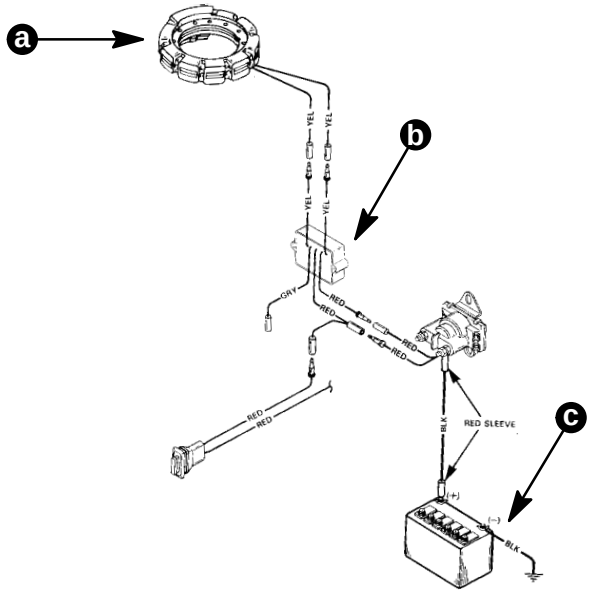
Some models are equipped with either a voltage regulator or a voltage regulator/rectifier. The voltage regulator senses battery voltage and allows the correct amount of direct current to charge the battery.

Models Equipped With Rectifier



a - Stator
b - Rectifier
c - Battery

Models Equipped With Regulator/Rectifier



a - Stator
b - Regulator/Rectifier
c - Battery

The charging system may be damaged by: 1) reversed battery cables, 2) running the engine with battery cables disconnected and stator leads connected to rectifier, and 3) and open circuit, such as a broken wire or loose connection.

Battery Charging System Troubleshooting

A fault in the battery charging system usually will cause the battery to become undercharged. Check battery electrolyte level, and charge battery. See “Electrolyte Level”, and “Charging a Discharged Battery”.

If battery will NOT accept a satisfactory charge, replace battery.

If battery accepts a satisfactory charge, determine the cause of the charging system problem as follows.

1. Check for correct battery polarity [red cable to positive (+) battery terminal]. If polarity was incorrect, check for damaged rectifier. See “Rectifier Test”.
2. Check for loose or corroded battery connections.
3. Visually inspect wiring between stator and battery for cuts, chafing; and disconnected, loose or corroded connection.
4. Excessive electrical load (from too many accessories) will cause battery to run down.

If visual inspection determines that battery connections and wiring are OK, perform the following stator and rectifier tests.

Stator Ohms Test (Alternator Coils Only)

NOTE: *Stator can be tested without removing from engine.*

1. Disconnect both yellow (stator leads) from voltage regulator/rectifier, or terminal block.
2. Use an ohmmeter and perform the following test.

IMPORTANT: If stator is mounted on engine, black stator lead (if provided) must be grounded to powerhead when testing.

3. Replace stator if readings are outside ranges shown.

NOTE: *When servicing a unit listed “Serial Number and Below”, it is recommended that the flywheel be removed and the stator part number verified to determine proper testing applications.*

55/60 MARATHON/SEAPRO – (398-9873A-5 or 398-9873A21 printed on the stator)

LIGHTING COIL STATOR - 7 AMPERE (96 WATTS)

Test Leads	Resistance (OHMS)	Scale Reading (x_____)
Between Yellow Stator Leads	.12 – .23*	.12 – .23* (R x 1)
Between Either Yellow Stator Lead and Engine Ground**	No Continuity	No Continuity (R x 1000)
Between Blue/ White and Black Stator Leads	100 – 140	10 – 14 (R x 10)

* DC Resistance of these windings generally is less than 1.5 OHMS. If a reading (resembling a short) is obtained, this would be acceptable.

** If stator is removed from engine, connect test lead to black stator lead, if provided.

45 JET, 50/60 ELECTRIC – (398-9710A22, 398-9710A23, or 398-9710A34 printed on the stator)
USA S/N 0G277605 and BELOW
BELGIUM S/N (Not Available at Time of Printing)

9 AMPERE STATOR

Test Leads	Resistance (OHMS)	Scale Reading (x_____)
Between Yellow Stator Leads	.6 – 1.1*	.6 – 1.1* (R x 1)
Between Either Yellow Stator Lead and Engine Ground**	No Continuity	No Continuity (R x 1000)

16 AMPERE STATOR

Test Leads	Resistance (OHMS)	Scale Reading (x_____)
Between Yellow Stator Leads	.17 – .19*	.17 – .19* (R x 1)
Between Either Yellow Stator Lead and Engine Ground**	No Continuity	No Continuity (R x 1000)

* DC Resistance of these windings generally is less than 1.5 OHMS. If a reading (resembling a short) is obtained, this would be acceptable.

** If stator is removed from engine, connect test lead to black stator lead, if provided.

45 JET, 50/60 ELECTRIC – (398-9873A24 printed on the stator)
USA S/N 0G277606 and ABOVE
BELGIUM S/N (Not Available at Time of Printing)

15 AMPERE STATOR

Test Leads	Resistance (OHMS)	Scale Reading (x_____)
Between Yellow Stator Leads	.20 – .25*	.20 – .25* (R x 1)
Between Either Yellow Stator Lead and Engine Ground**	No Continuity	No Continuity (R x 1000)

* DC Resistance of these windings generally is less than 1.5 OHMS. If a reading (resembling a short) is obtained, this would be acceptable.

** If stator is removed from engine, connect test lead to black stator lead, if provided.

Alternator System Test

UNREGULATED SYSTEMS

IMPORTANT: Rectifier must be functioning properly for accurate test results to be obtained.

1. If engine is equipped with a voltage regulator, disconnect voltage regulator leads at rectifier; re-install hex nut on rectifier terminal that has yellow stator lead.
2. Remove red wire from (+) terminal of rectifier.
3. Connect red (+) ammeter lead to rectifier (+) terminal and black (-) ammeter lead to red rectifier wire.
4. Run engine at 3000 RPM.
5. Meter should read 7-9 amperes; if not, replace stator.

REGULATED SYSTEMS

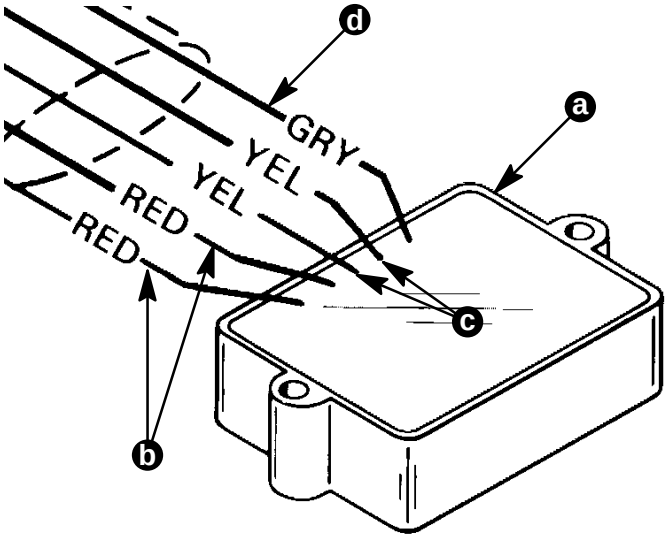
1. Check battery voltage at battery with engine running.
2. If battery voltage is above 14.5 volts, replace voltage regulator/rectifier. Check condition of battery as overcharging may have damaged battery.
3. If battery voltage is below 14.5 volts, charge battery; refer to “Charging a Discharged Battery”. If battery can NOT be satisfactorily charged, replace battery.
4. If battery accepts a satisfactory charge, check battery voltage while cranking engine; refer to “Charging a Discharged Battery”. If cranking voltage is not acceptable, replace battery.
5. If cranking voltage is acceptable, disconnect larger diameter RED harness wire from starter solenoid terminal.
6. Remove smaller diameter RED wire (sense lead) from starter solenoid terminal and connect to the positive (+) terminal of a 9 volt transistor battery. Ground the negative (–) terminal of the 9 volt battery to the engine.
7. Connect RED (+) ammeter lead to larger diameter RED harness wire, and BLACK (–) ammeter lead to positive terminal on starter solenoid.
8. Secure starter wires away from flywheel.
9. With engine running at the indicated RPM’s, the ammeter should indicate the following appropriate amperes:

9 AMP	
RPM	**AMPERES**
Idle	1
1000	4
2000	8
3000	9

16 AMP	
RPM	**AMPERES**
Idle	2
1000	10
2000	16
3000	18

15 AMP	
RPM	**AMPERES**
Idle	3.5
1000	8
2000	13
3000	14

10. A reading of 18 amperes (16 amp system) or 9 amperes (9 amp system) at 3000 RPM indicates the charging system is functioning properly and the battery being discharging current due to the amperage draw on the system is greater than the amperage output of the engine charging system.
11. If ammeter reads less than required amperes @ 3000 RPM, test the stator; refer to “Stator Ohm Test (Alternator Coils Only)”. If stator tests OK, replace voltage regulator.

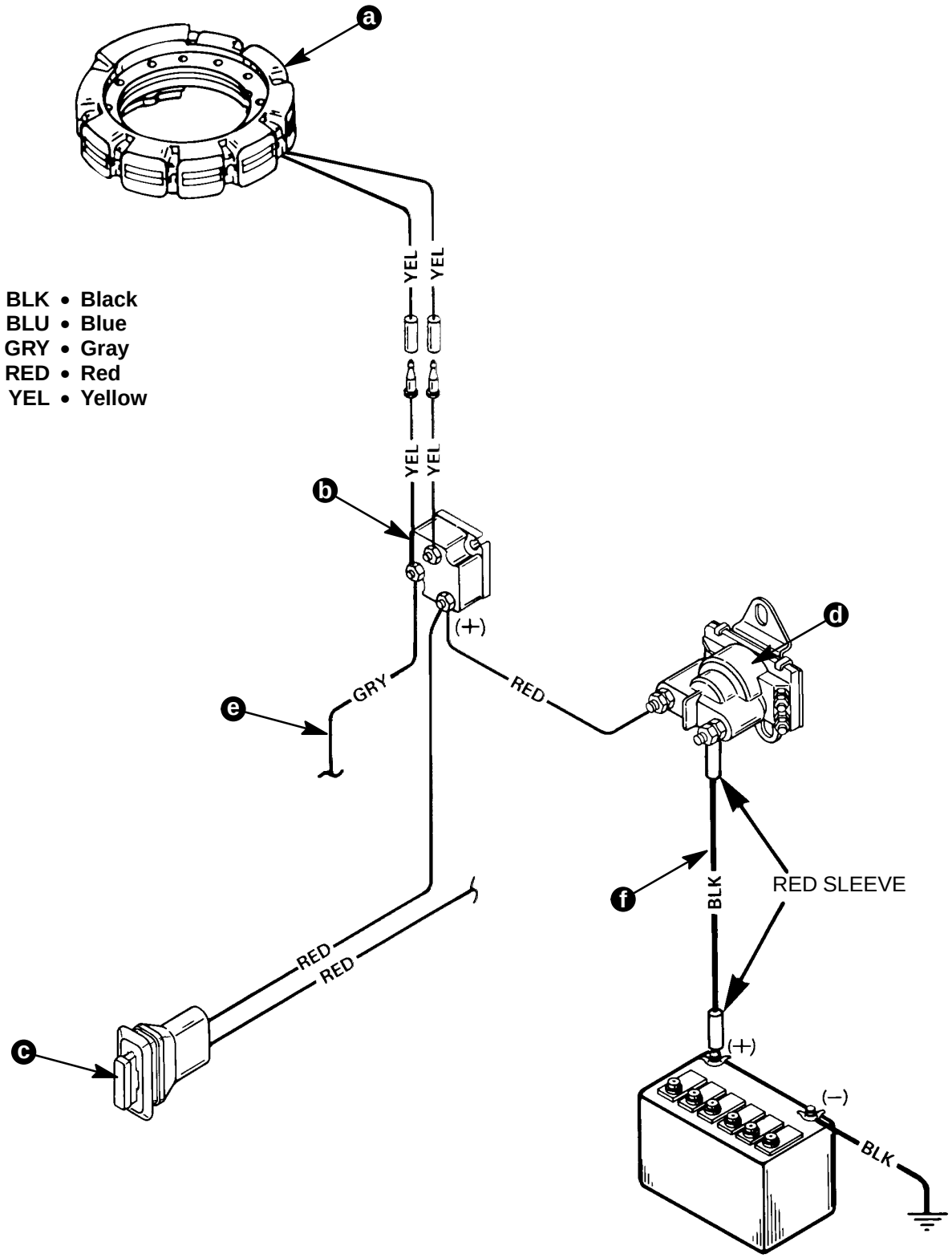


51000

a - Voltage Regulator/Rectifier
b - Red Lead (2)
c - Yellow Lead (2)
d - Grey Lead

9 Ampere Battery Charging Wiring Diagram

(RECTIFIER MODELS)



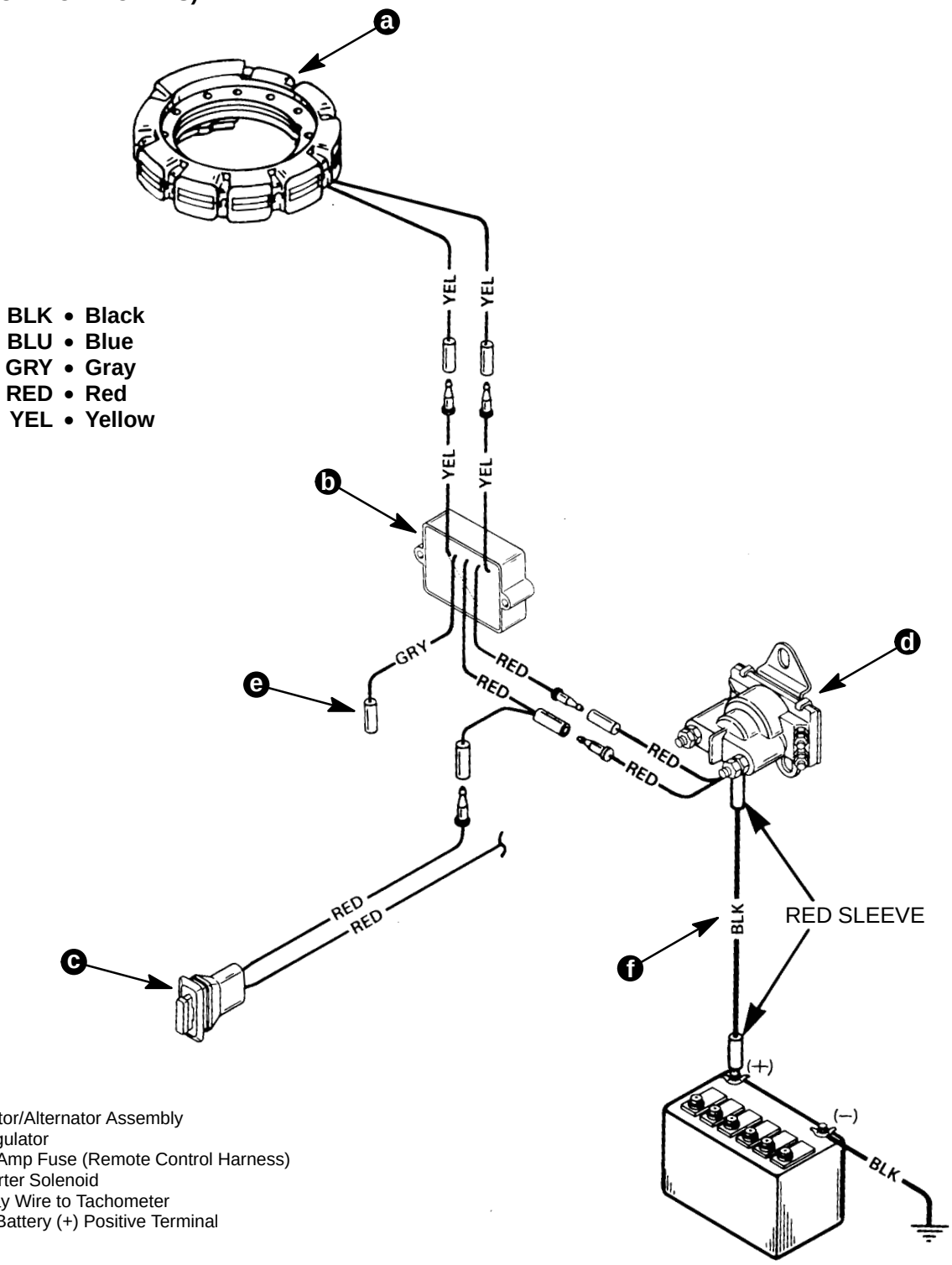
IMPORTANT: After electrical connections are made, coat all terminal connections using Quicksilver Liquid Neoprene (92-25711), to avoid corrosion.

a - Stator/Alternator Assembly
b - Rectifier
c - 20 Ampere Fuse (Remote Control Harness)
d - Starter Solenoid
e - GRAY Wire to Tachometer
f - To Battery (+) Positive Terminal

9 Ampere Battery Charging Wiring Diagram

IMPORTANT: After electrical connections are mad coat all terminal connections using Quicksilver Liqu Neoprene (92-25711), to avoid corrosion.

(REGULATOR MODELS)



BLK • Black
BLU • Blue
GRY • Gray
RED • Red
YEL • Yellow

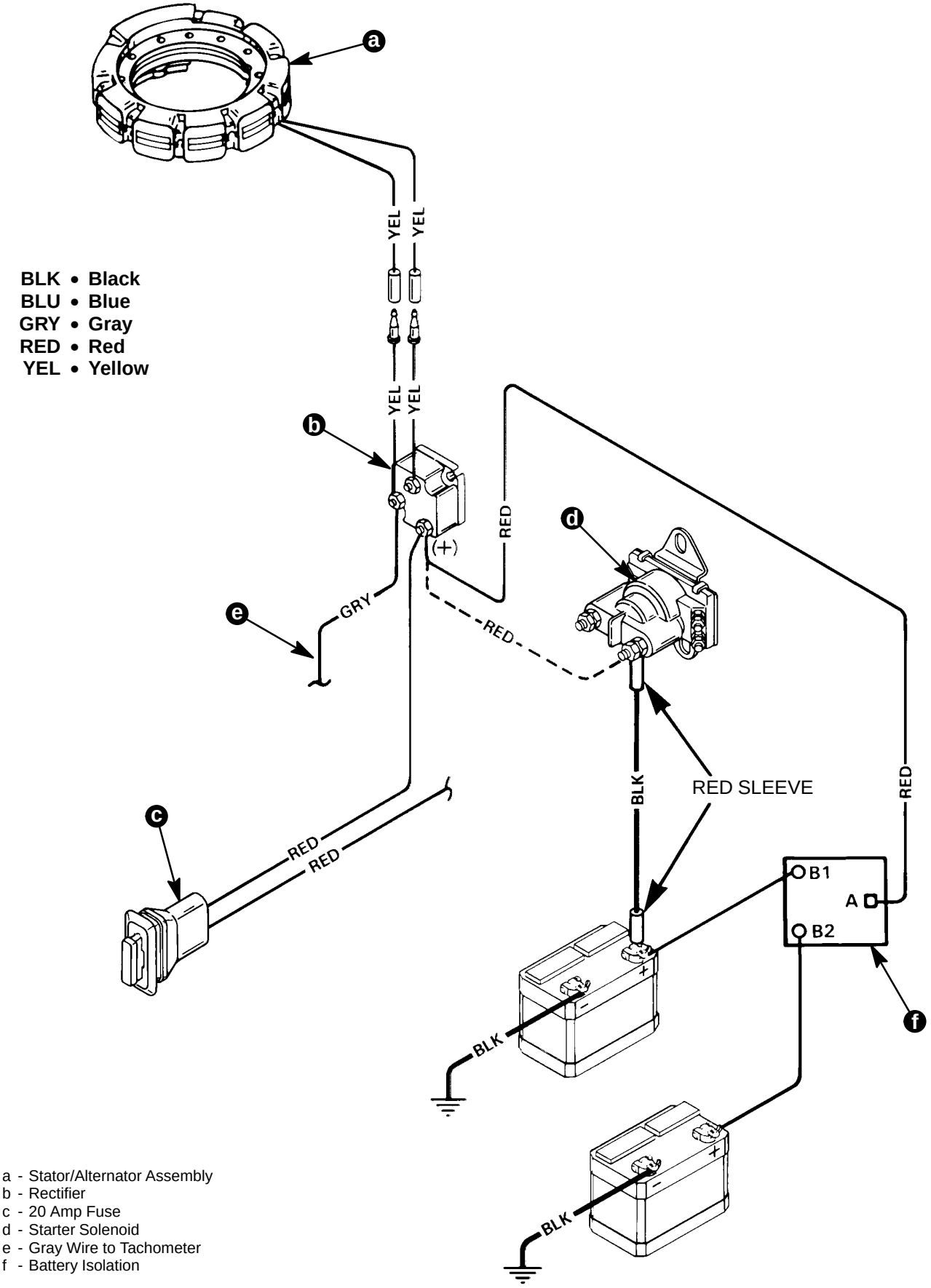
a - Stator/Alternator Assembly
b - Regulator
c - 20 Amp Fuse (Remote Control Harness)
d - Starter Solenoid
e - Gray Wire to Tachometer
f - To Battery (+) Positive Terminal

51249

9 Ampere Battery Charging Diagram with Battery Isolator

IMPORTANT: After electrical connections are made, coat all terminal connections using Quicksilver Liquid Neoprene (92-25711), to avoid corrosion.

(RECTIFIER MODELS)

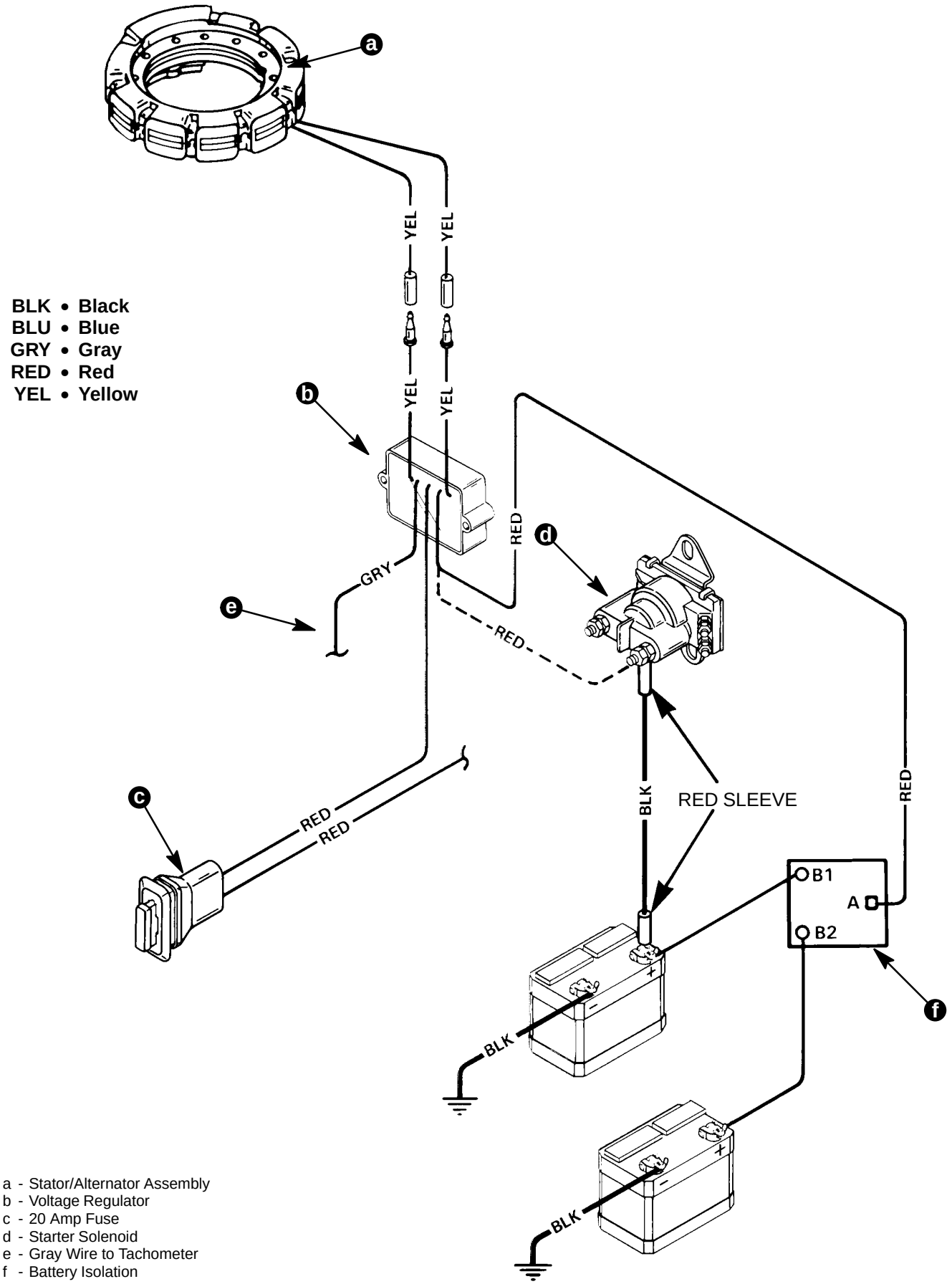


a - Stator/Alternator Assembly
b - Rectifier
c - 20 Amp Fuse
d - Starter Solenoid
e - Gray Wire to Tachometer
f - Battery Isolation

51251

15/16 Ampere Battery Charging Diagram with Battery Isolator

IMPORTANT: After electrical connections are made, coat all terminal connections using Quicksilver Liquid Neoprene (92-25711), to avoid corrosion.



a - Stator/Alternator Assembly
b - Voltage Regulator
c - 20 Amp Fuse
d - Starter Solenoid
e - Gray Wire to Tachometer
f - Battery Isolation

51250

Rectifier Test

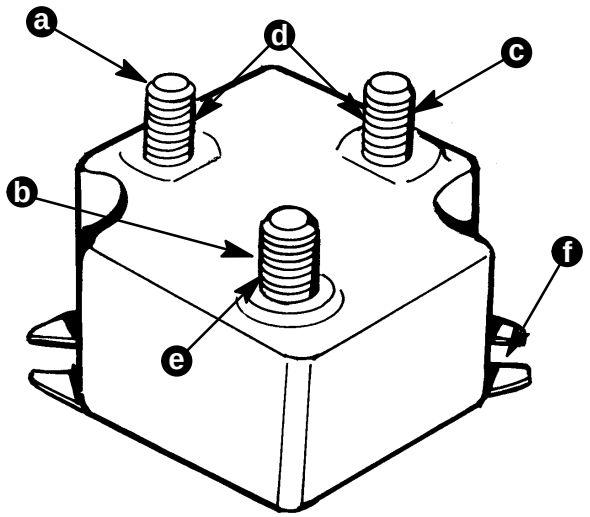
⚠ WARNING

Disconnect battery leads from battery before testing rectifier.

NOTE: *Rectifier can be tested without removing from engine.*

1. Disconnect all wires from terminals on rectifier.
2. Use an ohmmeter (R x 1000 scale) and perform the following test. Refer to drawing for rectifier terminal identification.

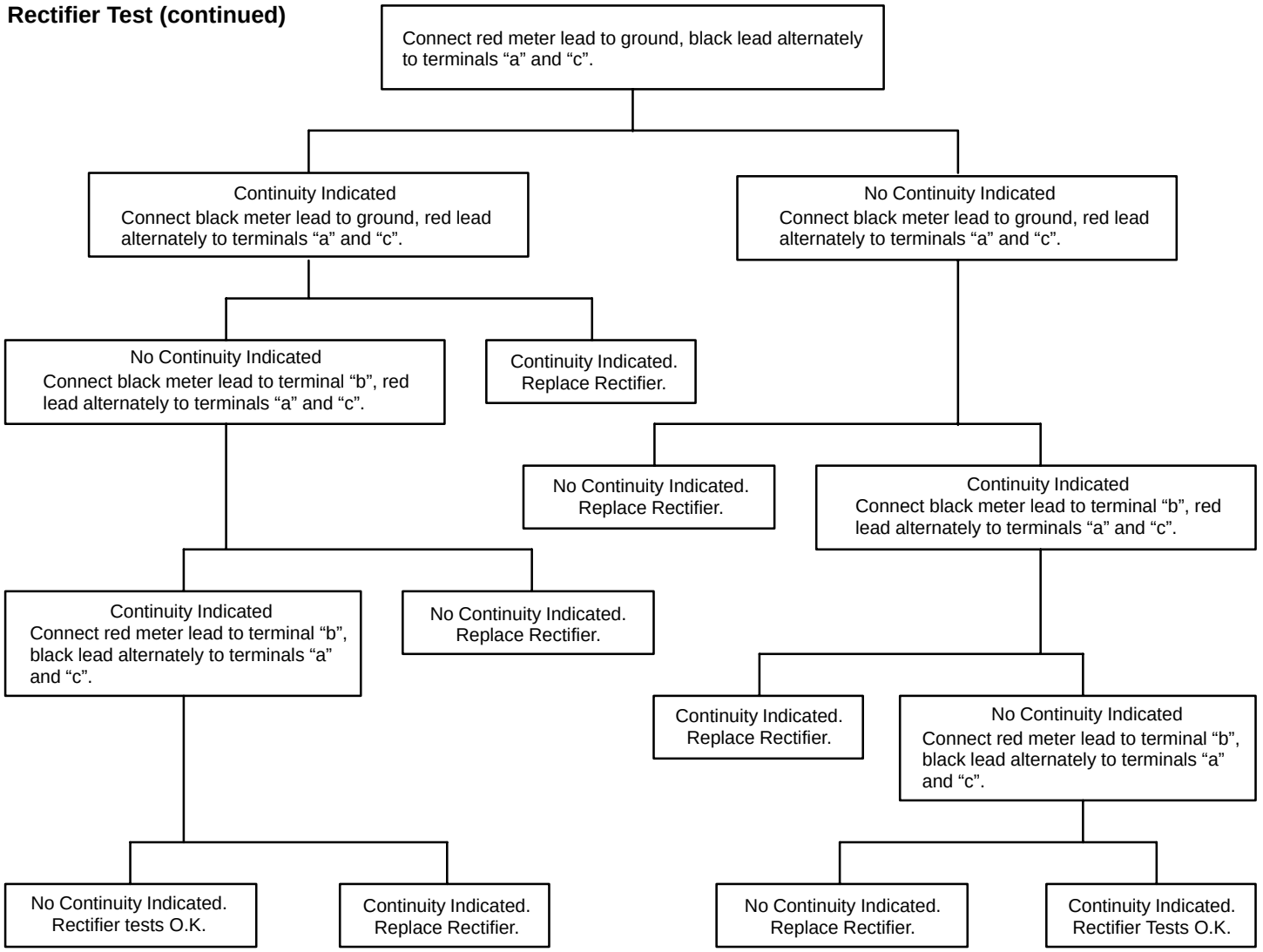
NOTE: *Due to differences in the manufacture of ohm meters, the internal battery polarity may vary from manufacturer to manufacturer. As a result, the test readings may be a direct reversal of those listed. If so, reverse meter leads and reperform test.*



07300

a - Terminal
b - Terminal
c - Terminal
d - Stator Terminals
e - Positive Terminal
f - Ground

Rectifier Test (continued)


Connect red meter lead to ground, black lead alternately to terminals “a” and “c”.
Continuity Indicated
Connect black meter lead to ground, red lead alternately to terminals “a” and “c”.
No Continuity Indicated
Connect black meter lead to ground, red lead alternately to terminals “a” and “c”.
No Continuity Indicated
Connect black meter lead to terminal “b”, red lead alternately to terminals “a” and “c”.
Continuity Indicated. Replace Rectifier.
No Continuity Indicated. Replace Rectifier.
Continuity Indicated
Connect black meter lead to terminal “b”, red lead alternately to terminals “a” and “c”.
Continuity Indicated
Connect red meter lead to terminal “b”, black lead alternately to terminals “a” and “c”.
No Continuity Indicated. Replace Rectifier.
Continuity Indicated. Replace Rectifier.
No Continuity Indicated
Connect red meter lead to terminal “b”, black lead alternately to terminals “a” and “c”.
No Continuity Indicated. Rectifier tests O.K.
Continuity Indicated. Replace Rectifier.
No Continuity Indicated. Replace Rectifier.
Continuity Indicated. Rectifier Tests O.K.

Starting System

Starting System Components

The starting system consists of the following components.

1. Battery
2. Starter Solenoid
3. Neutral Start Switch
4. Starter Motor
5. Ignition Switch

Description

The function of the starting system is to crank the engine. The battery supplies electrical energy to crank the starter motor. When the ignition switch is turned to “Start” position, the starter solenoid is activated and completes the starting circuit between the battery and starter.

The neutral start switch opens the start circuit when the shift control lever is not in neutral. This prevents accidental starting when engine is in gear.

⚠ CAUTION

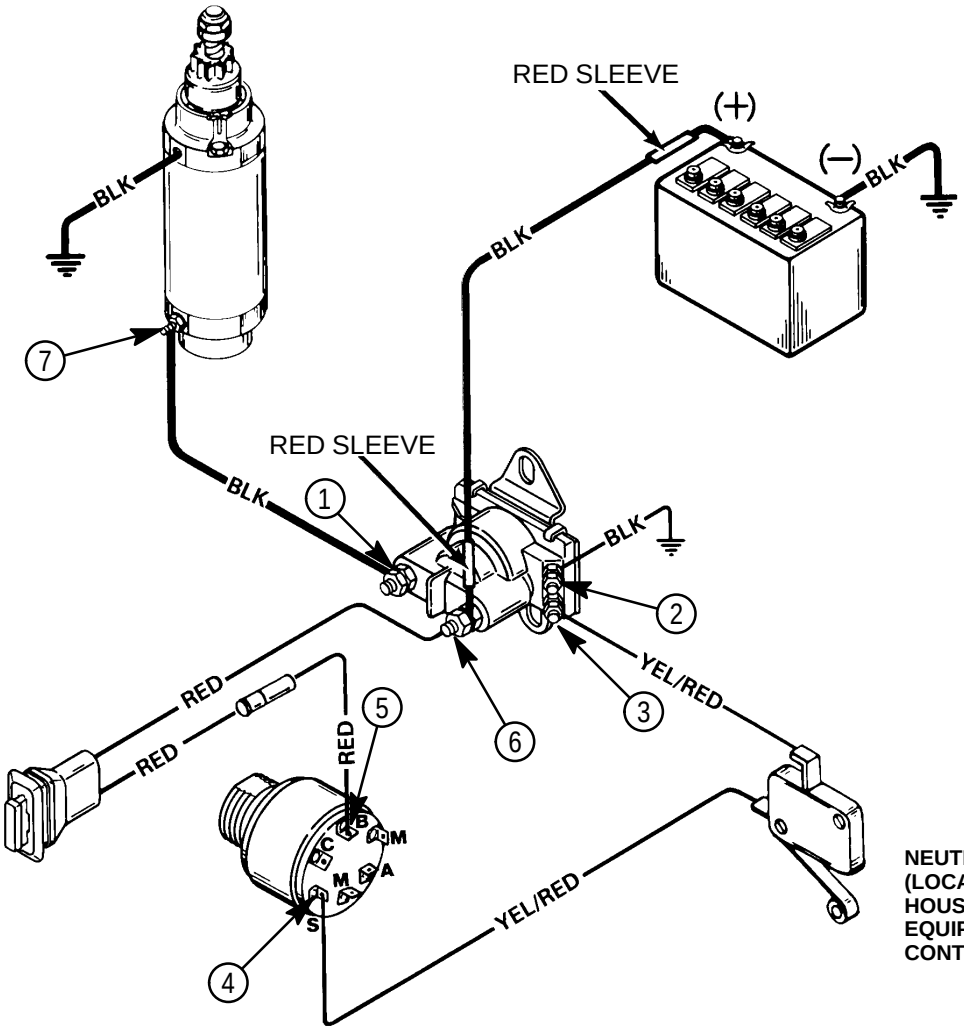
The starter motor may be damaged if operated continuously. DO NOT operate continuously for more than 30 seconds. Allow a 2 minute cooling period between starting attempts.

Troubleshooting the Starting Circuit

Before beginning the starting circuit troubleshooting flow chart, following, check first for the following conditions:

1. Make sure that battery is fully charged.
2. Check that control lever is in “neutral” position.
3. Check terminals for corrosion and loose connections.
4. Check cables and wiring for frayed and worn insulation.
5. Check in-line fuse in red wire; see diagram.

The following “Starting Circuit Troubleshooting Flow Chart” is designed as an aid to troubleshooting the starting circuit. This flow chart will accurately locate any existing malfunction. Location of “Test Points” (called out in the chart) are numbered in diagram below.



NEUTRAL START SWITCH (LOCATED IN CONTROL HOUSING IF ENGINE IS EQUIPPED WITH REMOTE CONTROL)

51208

Starting Circuit Troubleshooting Flow Chart

Starter Motor Does Not Turn

SAFETY WARNING: Disconnect black (starter motor) cable from starter solenoid test point 1 BEFORE making tests 1-thru-7 to prevent unexpected engine cranking.

TEST 1
Use an ohmmeter (R x 1 scale) and connect meter leads between negative (-) battery post and common powerhead ground.

No continuity indicated; there is an open circuit in the black negative (-) battery cable between the negative (-) battery post and the powerhead.
- Check cable for loose or corroded connections.
- Check cable for open.

Continuity Indicated
Proceed to TEST 2, on next page.

** Battery Voltage*

TEST 2
a. Disconnect black ground wire(s) from Test Point 2.
b. Connect voltmeter between common engine ground and Test Point 2.
c. Turn ignition key to “Start” position.

No voltage reading; proceed to TEST 3.

TEST 3
a. Reconnect black ground wire(s).
b. Connect voltmeter between common engine ground and Test Point 3.
c. Turn ignition key to “Start” position.

12 Volt Reading*
Check black ground wire for poor connection or open circuit. Reconnect ground wire to starter solenoid; proceed to TEST 7.

No voltage reading; proceed to TEST 4.

12 Volt Reading
Defective starter solenoid.

TEST 4
a. Connect voltmeter between common engine ground and Test Point 4.
b. Turn ignition key to “Start” position.

12 Volt Reading*
Neutral start switch is open, or yellow/red wire is open between Test Points 4 and 3.

No voltage reading; proceed to TEST 5.

TEST 5
Connect voltmeter between common engine ground and Test Point 5.

12 Volt Reading*
Defective ignition switch.

No voltage reading; proceed to TEST 6.

TEST 6
Connect voltmeter between common engine ground and Test Point 6.

No voltage reading; check red wire between battery (+) positive terminal and Test Point 6.

12 Volt Reading*
Check fuse in red wire between test points 5 and 6.
Check for open red wire between test points 5 and 6.

TEST 7
a. Connect voltmeter between common engine ground and Test Point 1.
b. Turn ignition key to “Start” position.

No voltage reading; Defective starter solenoid.

12 Volt Reading*
Should hear solenoid click; proceed to TEST 8.

TEST 8
a. Reconnect black (starter motor) cable to starter solenoid Test Point 1.
b. Connect voltmeter between common engine ground and Test Point 7
c. Turn ignition key to “Start” position.

No voltage reading; check black cable for poor connection or open circuit.

12 Volt Reading*
Check black ground cable at starter for loose or corroded connection, or open circuit. If cable is O.K., check starter motor.

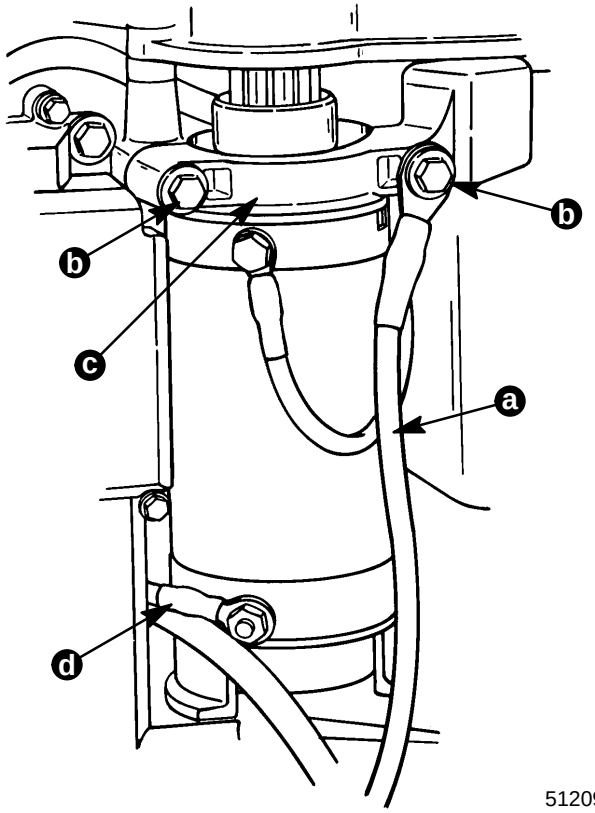
Starter Motor

Removal

⚠CAUTION

Disconnect battery leads from battery before removing starter.

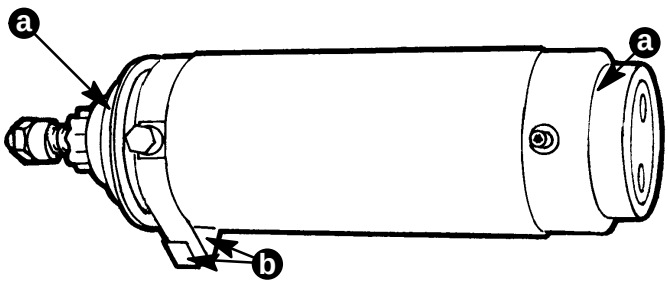
1. Disconnect battery leads from battery.
2. Disconnect black cable.
3. Remove bolts and remove starter clamp.
4. Remove starter.
5. Remove black cable.



51209

a - Black Cable
b - Bolts (2)
c - Starter Clamp
d - Black Cable

6. Remove 2 rubber collars and 2 rubber bumpers

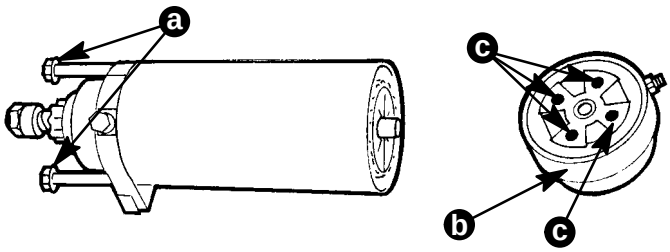


11645

a - Rubber Collars
b - Rubber Bumpers

Disassembly

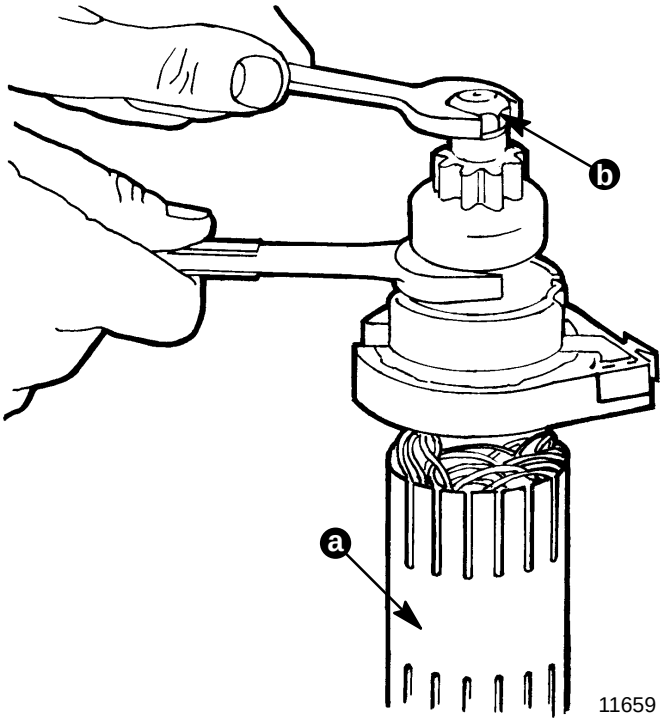
1. Remove 2 thru bolts and commutator end cap, taking care not to lose brush springs.



11646

a - Thru Bolts
b - Commutator End Cap
c - Brush Springs

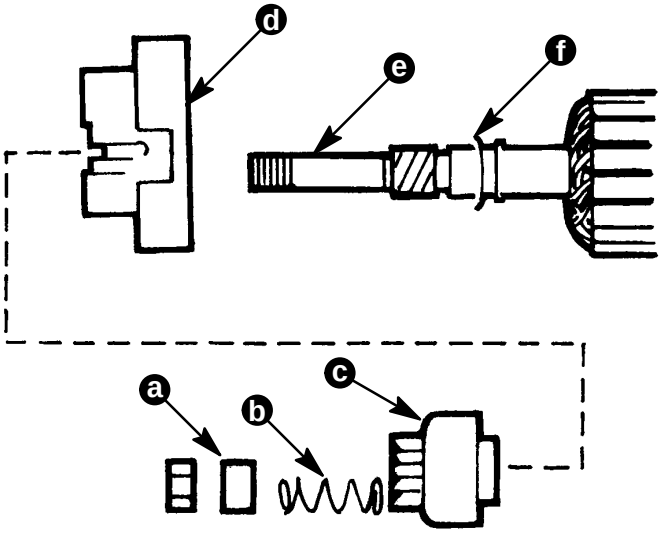
2. Pull armature from starter frame.
3. Remove locknut.



11659

a - Armature
b - Locknut

4. Remove components from armature.



11658

a - Spacer
b - Spring
c - Drive Assembly
d - Drive End Cap
e - Armature Shaft
f - Washer

Cleaning and Inspection

1. Clean all motor parts.
2. Check pinion teeth for chips, cracks or excessive wear.
3. Replace the drive clutch spring and/or collar, if tension is not adequate, or if wear is excessive.
4. Check that the brush holder is not damaged or is not holding the brushes against the commutator.
5. Replace brushes that are pitted or worn to less than 1/4" (6.4mm) in length. Refer to "Brush Replacement", following.
6. Replace a damaged or excessively worn bushing in the end cap.
7. Check the armature conductor (commutator bar junction) for a firm connection. A poor connection usually results in a burned commutator bar.
8. Re-surface and undercut a rough commutator, as follows:

⚠CAUTION

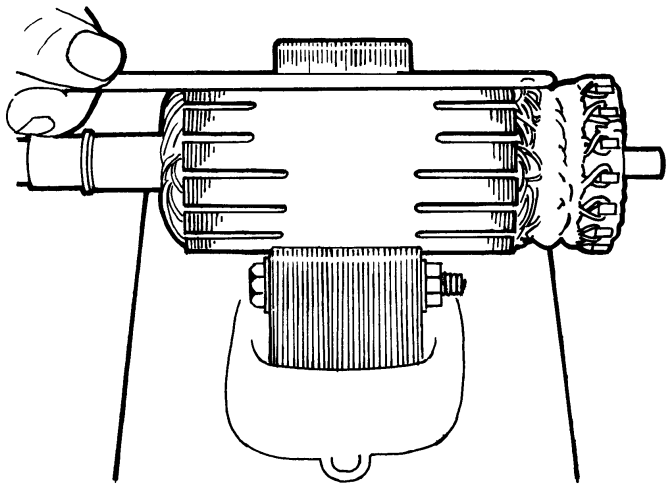
Do not turn down the commutator excessively.

   a. Re-surface the commutator and undercut the insulation between the commutator bars 1/32″ (0.8mm) to the full width of the insulation, make sure that the undercut is flat.
   b. Clean the commutator slots after undercutting.
   c. De-burr the commutator lightly with No. 00 sandpaper, then clean the commutator.
   d. Check the armature on a growler for shorts. See "Testing", following.
9. Open-circuited armatures often can be saved where and open circuit is obvious and repairable. The most likely place for an open circuit is at the commutator bars. Long cranking periods overheat the starter motor so that solder in the connections melts. The poor connections cause arcing and burning of the commutator bars.
10. Repair bars, that are not too badly burned, by re-soldering the leads in bars (using rosin flux solder) and turning down the commutator in a lathe to remove burned material, then undercut the mica.
11. Clean out the copper or brush dust from slots between the commutator bars.
12. Check the armature for shorts and ground. See "Testing".

Testing

ARMATURE TEST FOR SHORTS

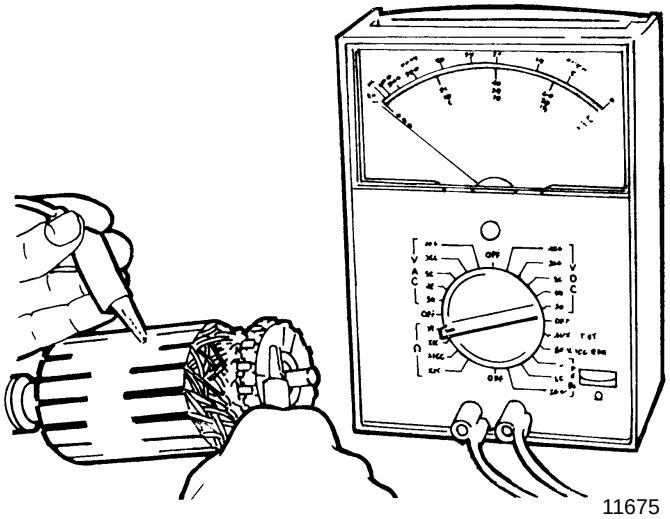
Check armature for short circuits by placing on growler and holding hack saw blade over armature core while armature is rotated. If saw blade vibrates, armature is shorted. Recheck after cleaning between commutator bars. If saw blade still vibrates, replace armature.



11669

ARMATURE TEST FOR GROUND

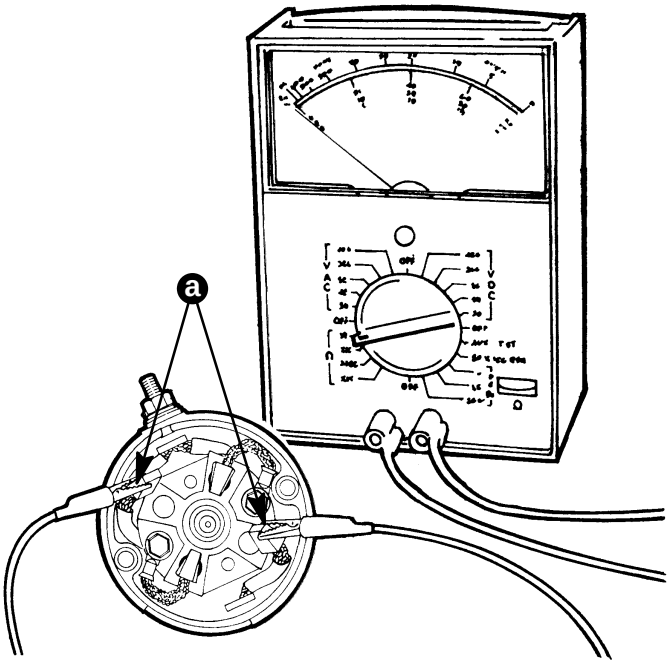
1. Set ohmmeter to (R x 1 scale). Place one lead of ohmmeter on armature core (or shaft) and other lead on commutator, as shown.
2. If meter indicates continuity, armature is grounded and must be replaced.



11675

CHECKING POSITIVE BRUSHES AND TERMINALS

1. Connect ohmmeter (R x 1 scale) leads between positive brushes.
2. Ohmmeter must indicate full continuity (zero resistance). If resistance is indicated, check lead to positive terminal solder connection. If connection cannot be repaired, brushes must be replaced. Refer to “Brush Replacement”.

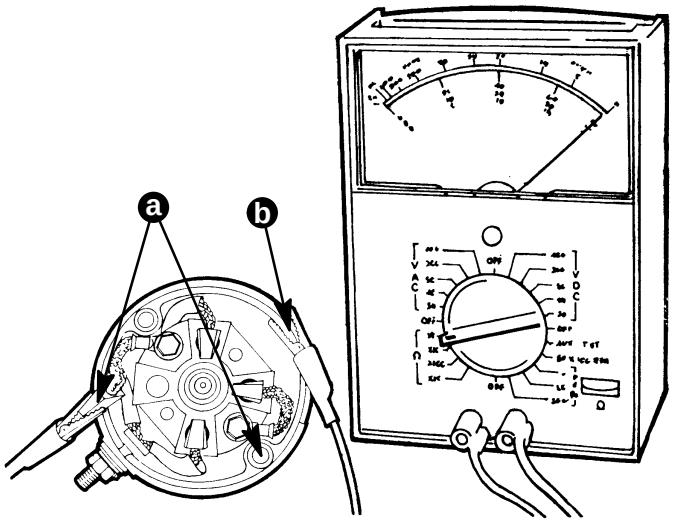


11673

a - Positive Brushes

TESTING NEGATIVE BRUSHES FOR GROUND

Set ohmmeter to (R x 1 scale). Place one lead of ohmmeter on the negative brush and the other lead on the end cap (bare metal). If the meter indicates NO continuity, replace the negative brush. Repeat this procedure on the other negative brush.



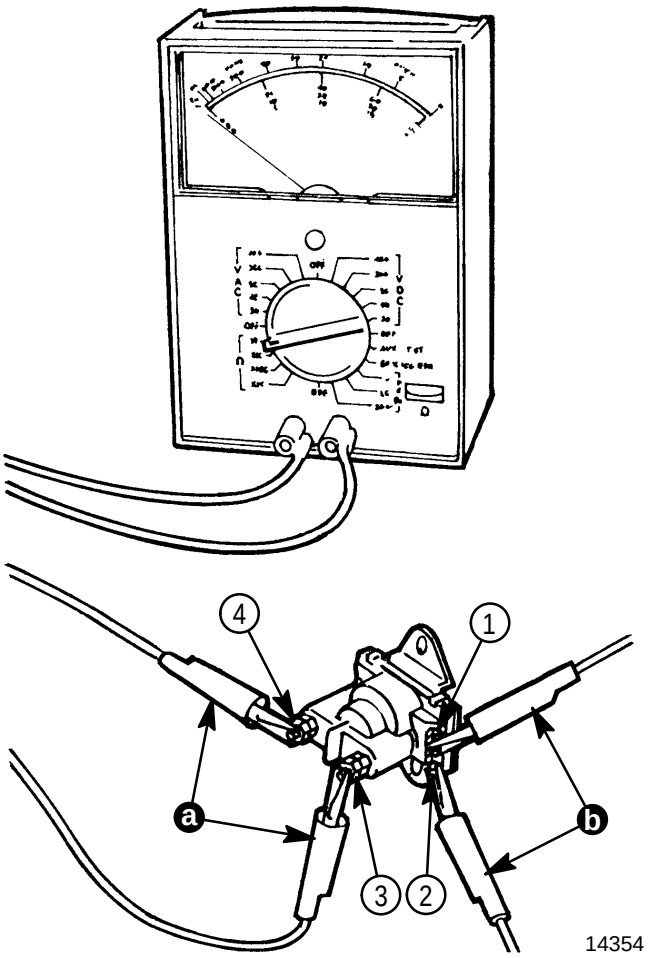
11674

a - Negative (-) Brushes
b - End Cap

STARTER SOLENOID TEST

Test starter solenoid as follows:

1. Disconnect all leads from solenoid terminals.
2. Use an ohmmeter, set to (R x 1 scale) and connect between solenoid terminals 1 and 2.
3. Connect a 12-volt supply between solenoid terminals 3 and 4. Solenoid should click and meter should read zero ohms.
4. If meter does not read zero ohms (full continuity), replace solenoid.



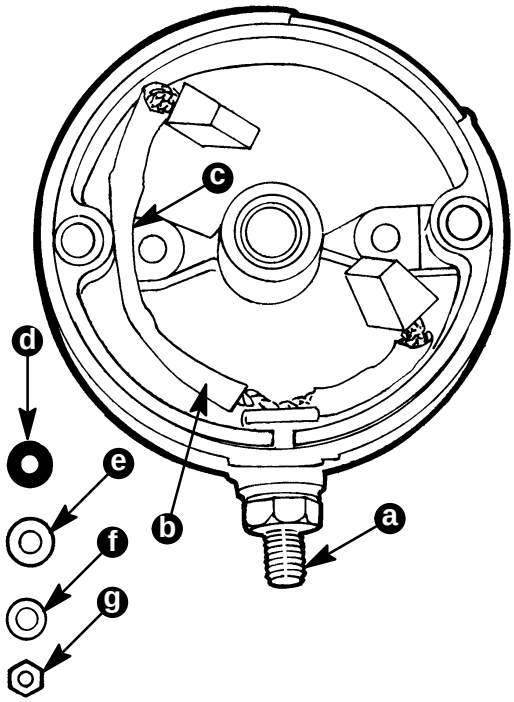
14354

a - 12-Volt Supply
b - Ohmmeter Leads

Brush Replacement

IMPORTANT: Replace brushes that are pitted or worn to less than 1/4" (6.4mm) in length.

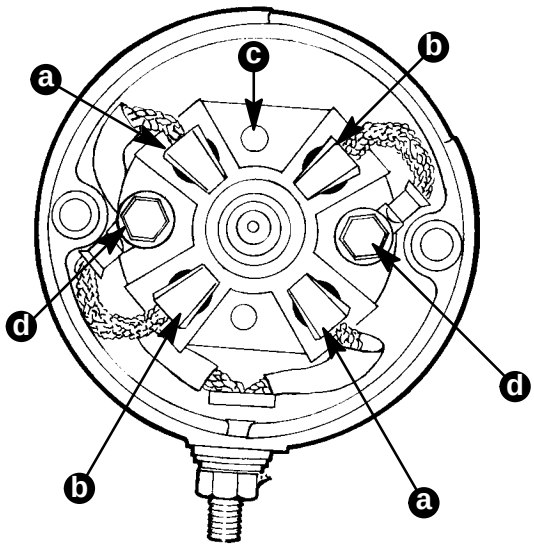
1. Install positive brushes into commutator end cap.



11660

a - Positive (+) Terminal
b - Long Brush Lead
c - Push Lead Into Slot
d - Insulating Washer
e - Flat Washer
f - Lock Washer
g - Nut

2. Install components.

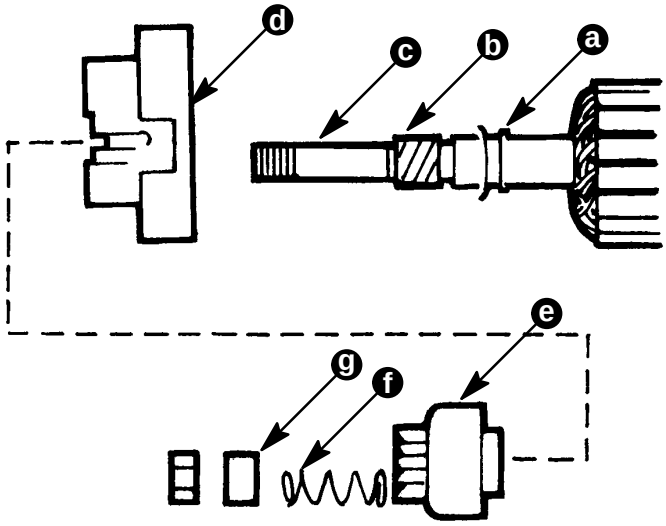


11656

a - Positive (+) Brushes
b - Negative (-) Brushes
c - Brush Holder
d - Bolts (Fasten Negative Brushes and Holder)

Reassembly

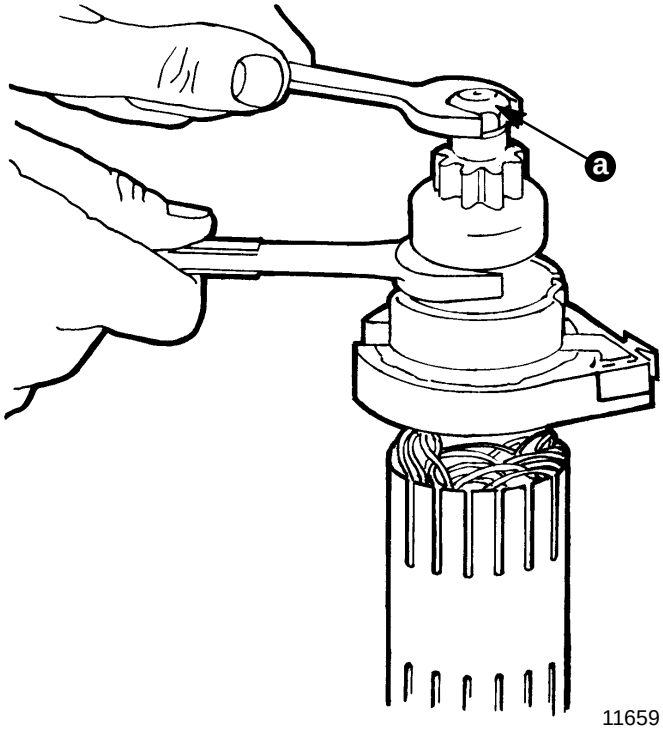
1. Lubricate helix threads and drive end cap bushing with SAE 10W oil.
2. Install components onto armature shaft.



11658

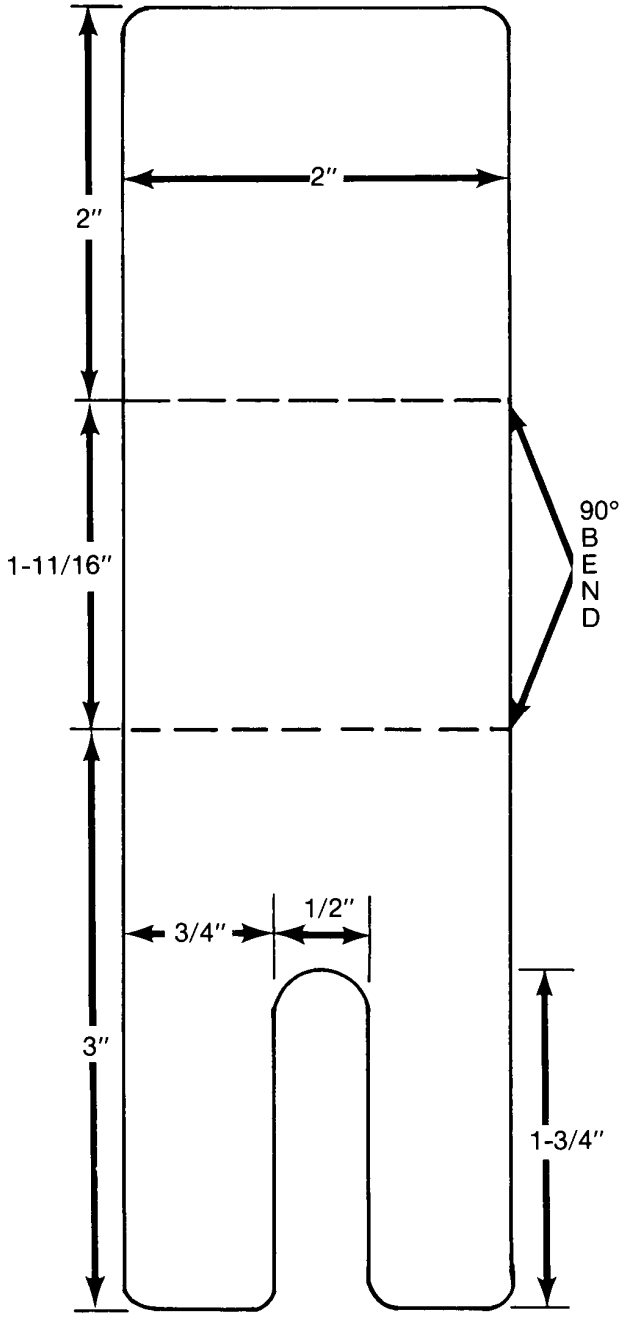
a - Washer
b - Helix Threads
c - Armature Shaft
d - Drive End Cap
e - Drive Assembly
f - Spring
g - Spacer

3. Install locknut (a).

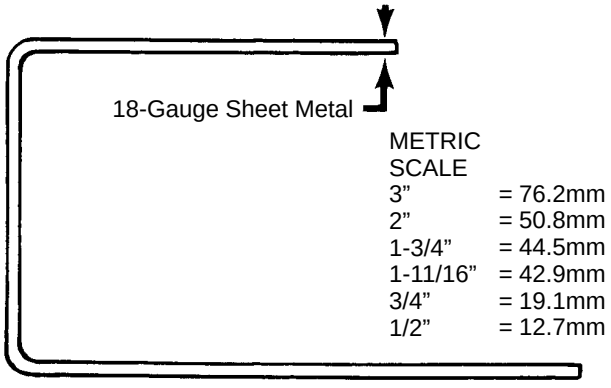


11659

4. Construct a brush retainer tool as shown.

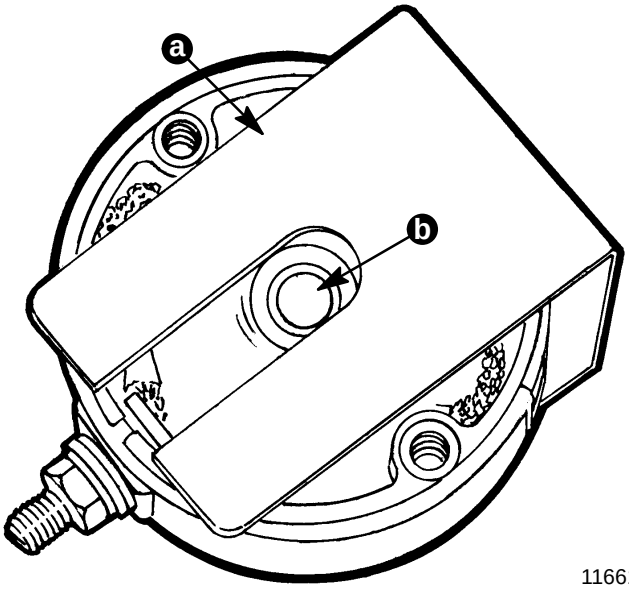


Brush Retainer Tool Layout (Full Size)



Brush Retainer Tool Side View (Full Size)

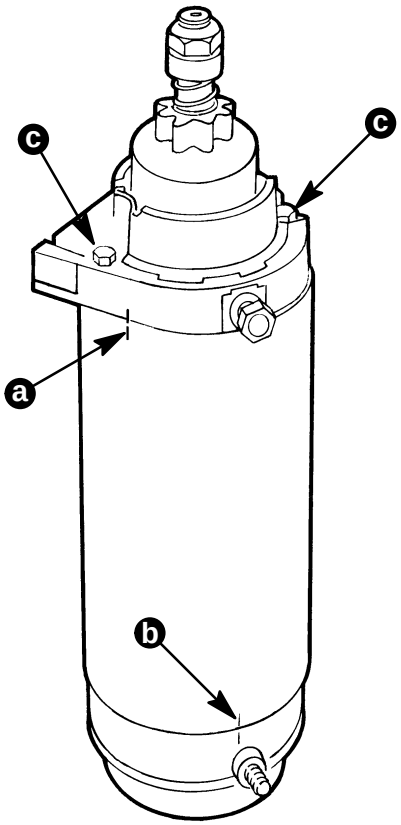
5. Place springs and brushes into brush holder and hold in place with brush retainer tool.
6. Lubricate bushing with one drop of SAE 10W oil. DO NOT over-lubricate.



11661

a - Brush Retainer Tool
b - Bushing

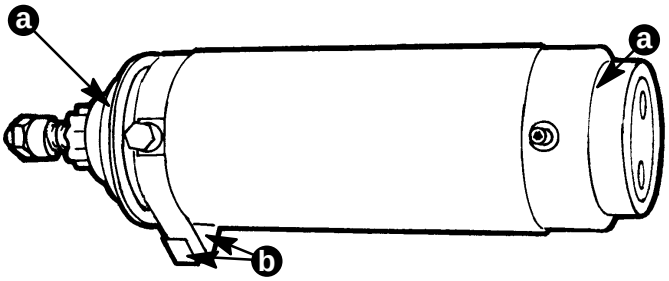
7. Position armature into starter frame so that commutator end of armature is at end of starter frame where permanent magnets are recessed 1” (25.4mm). Align marks (a) as shown.
8. Install commutator end cap onto starter frame; align marks (b) as shown, and remove brush retainer tool.
9. Install thru bolts (c) and torque to 70 lbs. in. (8 N·m).



11648

Installation

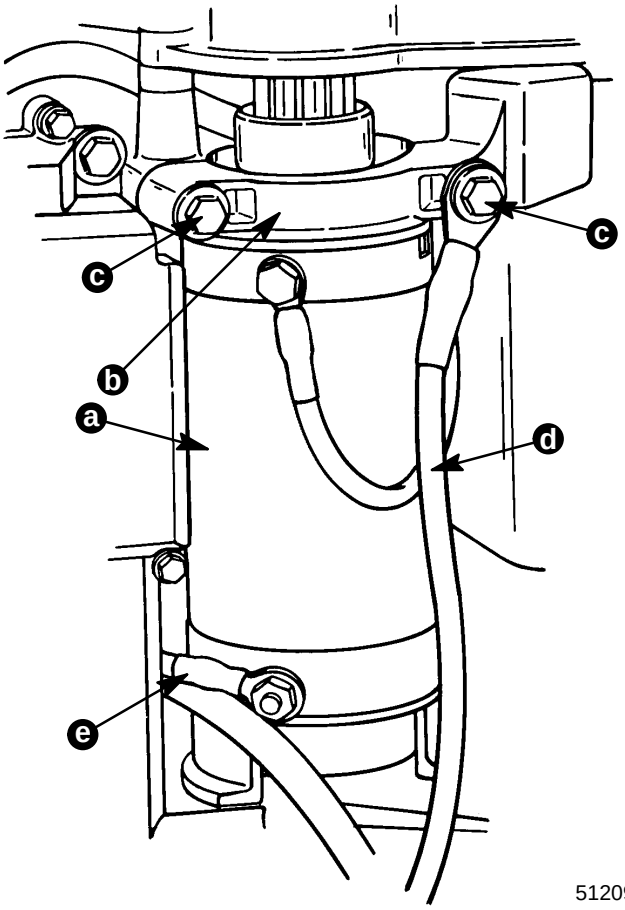
1. Install 2 rubber collars and 2 rubber bumpers.



11645

a - Rubber Collars
b - Rubber Bumpers

2. Install components as shown.
3. Connect battery leads to battery.



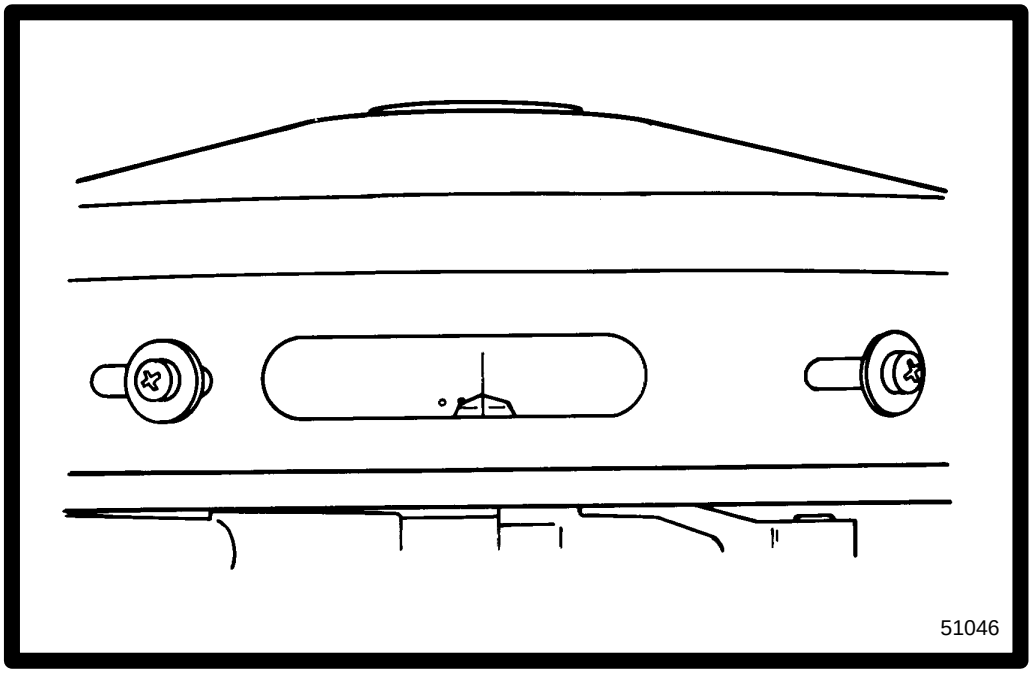
51209

a - Starter
b - Clamp
c - Bolts (2)
d - Black Cable (from Battery)
e - Black Cable (from Solenoid)

ELECTRICAL and IGNITION

2

C



TIMING/SYNCHRONIZING/ADJUSTING

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Timing/Synchronizing/ Adjusting

Specifications

FULL THROTTLE RPM	5000 - 5500 RPM	
IDLE TIMING	2 - 6° ATDC	
IDLE RPM IN (FORWARD GEAR)	650 - 750 RPM	
MAXIMUM TIMING @ 5000RPM (@ Cranking Speed)	**50/60**-22° BTDC **50/60**-24° BTDC	**55**-16° BTDC **55**-18° BTDC
SPARK PLUG TYPE 50/55/60	NGK BP8H-N-10 * NGK BPZ8H-N-10**	
FIRING ORDER	1 - 3 - 2	

* 50/55/60 Models, Serial No. D000750 to D181999, came standard with NGK BU8H spark plugs. NGK BP8H-N-10 can be used in these models.

** Suppressor (Resistor) Spark Plug.

Special Tools

Part Number	Description
*91-58222A1	Dial Indicator Gauge Kit
*91-59339	Service Tachometer
*91-99379	Timing Light
91-63998A1	Spark Gap Tool

*May be obtained locally.

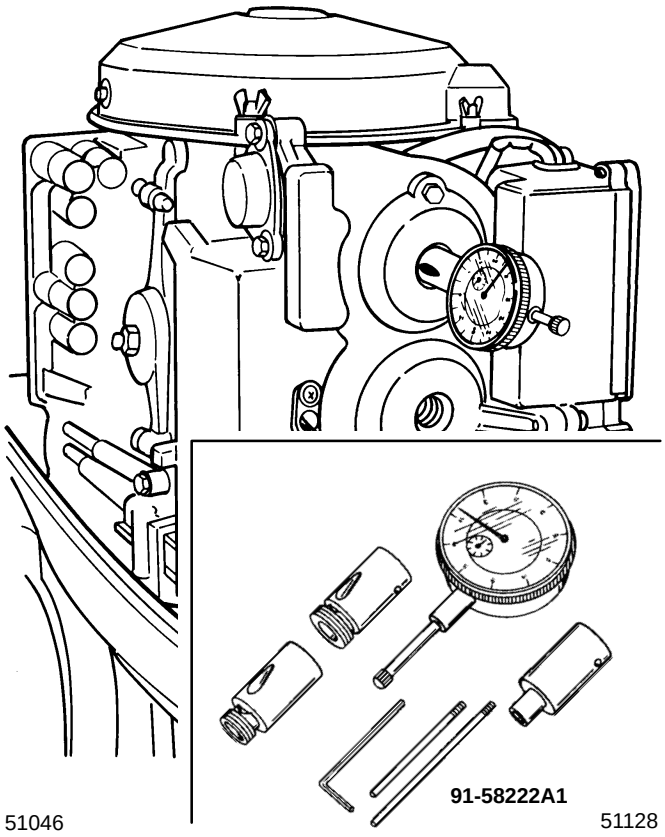
Timing Pointer Adjustment

IMPORTANT: Models equipped with adjustable timing pointer or .459 mark on flywheel require the following procedure before timing engine.

⚠ WARNING

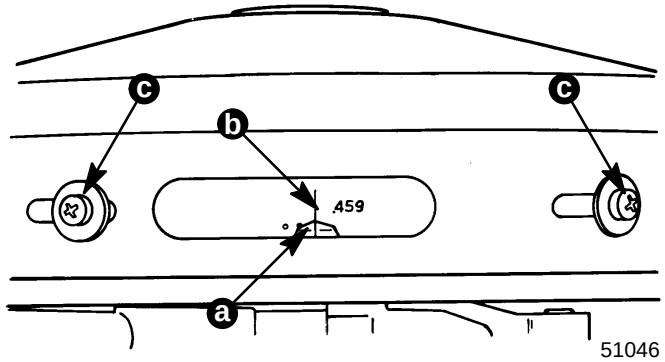
Remove all spark plugs from engine to prevent engine from starting.

1. Remove three (3) spark plugs.
2. Install dial indicator into No. 1 (TOP) cylinder.



51046 51128

3. Turn flywheel clockwise until No. 1 (TOP) piston is at top dead center (TDC). Set dial indicator to “0” (zero).
4. Turn flywheel counterclockwise until dial indicator needle reads .550 in. (14.0 mm) BTDC, then turn flywheel clockwise until needle reads .459 in. (11.7 mm) BTDC exactly.
5. Flywheel cover timing pointer (a) should align exactly with .459 (14.0 mm) timing mark (b) on flywheel. If not, loosen two (2) timing pointer attaching screws (c) and adjust pointer. After adjusting pointer, torque attaching screws to 20 lb. in. (2.26 N·m).



51046

6. Remove dial indicator from No. 1 (TOP) cylinder.

Carburetor Synchronization

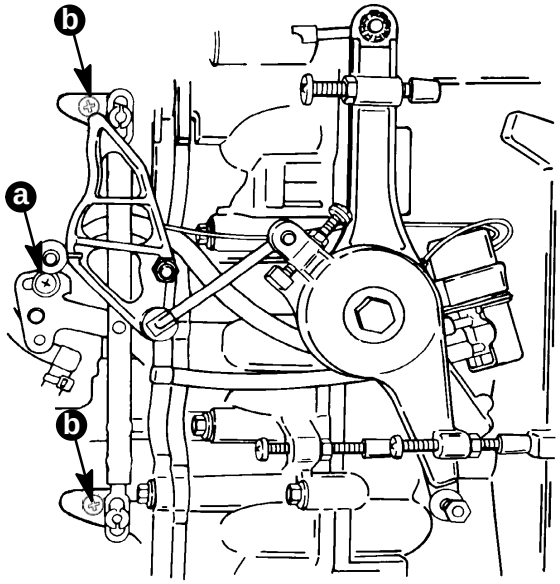
(MODELS WITH ONE PIECE THROTTLE LINK ROD)

a. Remove four (4) attaching screws from sound box cover and remove cover.

b. Loosen screw (a) of cam follower.

c. Loosen two (2) synchronizing screws (b) located on throttle levers of top and bottom carburetors.

d. Look into throats of carburetors and verify all throttle shutters are completely closed. Tighten synchronizing screws.



51045

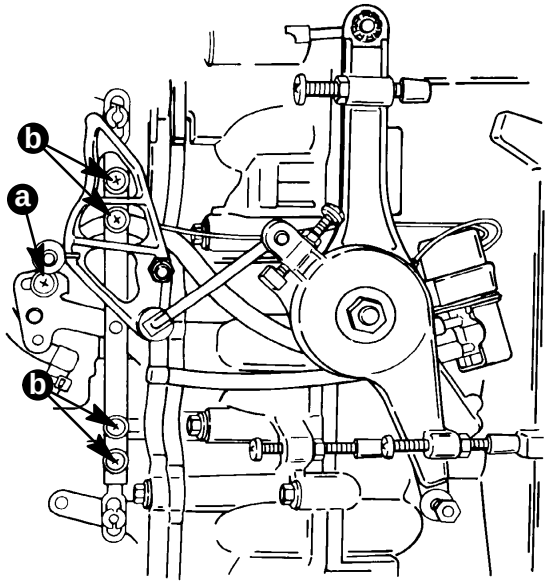
(MODELS WITH 4 ADJUSTABLE LENGTH THROTTLE LINK ROD)

a. Remove four (4) attaching screws from sound box cover and remove cover.

b. Loosen screw (a) of cam follower.

c. Loosen four (4) synchronizing screws (b) located on link rod.

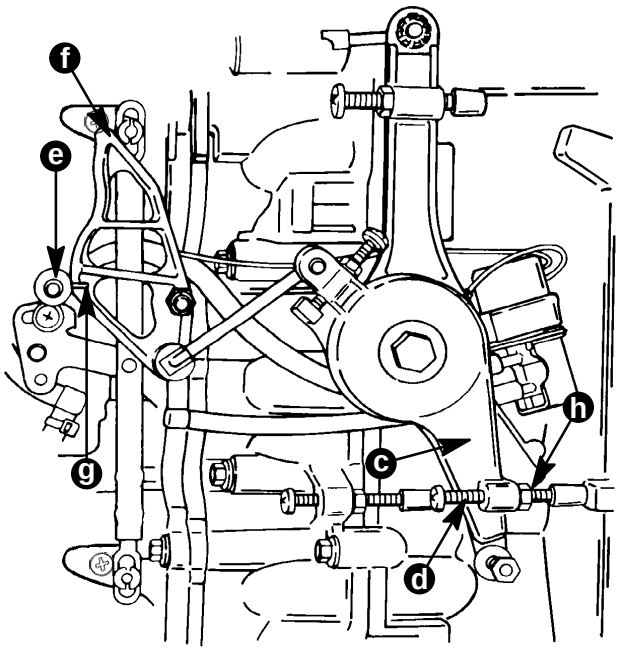
d. Look into throats of carburetors and verify all throttle shutters are completely closed. Tighten four (4) synchronizing screws (b).



51045

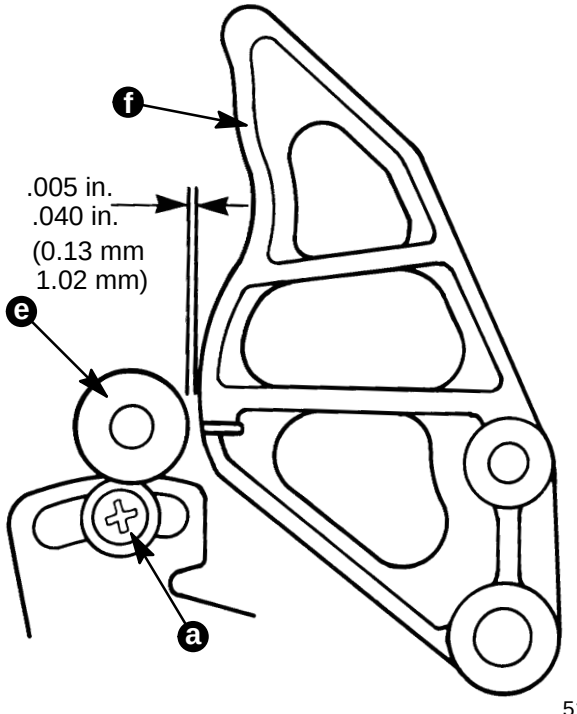
(BOTH ONE PIECE AND ADJUSTABLE LINK ROD)

1. Recheck throttle shutters and make any necessary adjustments.
2. Hold throttle arm (c) so that idle stop screw (d) is against stop.
3. Place roller (e) of cam follower against throttle cam (f) and adjust idle stop screw (d) to align raised mark (g) of throttle cam with center of cam follower roller. Tighten locknut (h).



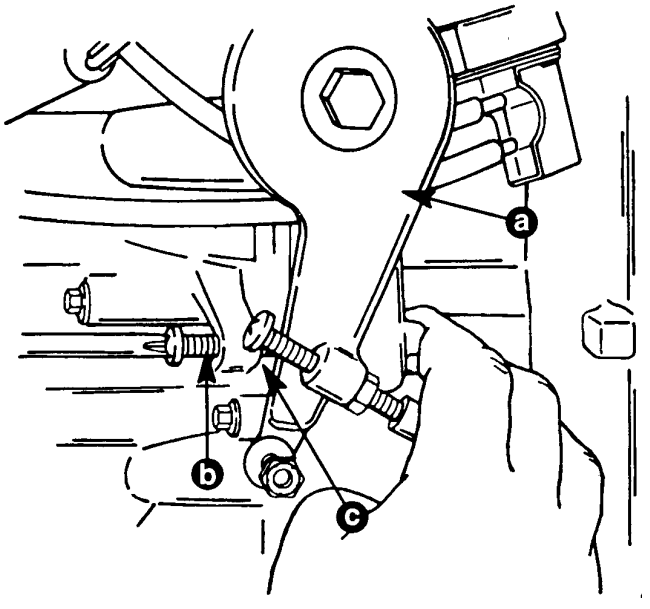
51045

4. Hold throttle arm at idle position. Adjust cam follower so that a clearance of .005 in.-.040 in.(0.13 mm-1.02 mm) exists between roller (e) of cam follower and throttle cam (f). Tighten screw (a) securing cam follower.



51069

5. Hold throttle arm (a) against full throttle stop screw (b). Adjust full throttle stop screw to allow throttle shutters to open fully while providing approximately .015 in. (.38 mm) freeplay in throttle linkage to prevent carburetor throttle shutters from acting as throttle stops at wide open throttle. Tighten locknut (c) on stop screw (b).



51045

6. Reinstall sound box cover.

Timing Adjustments

⚠ CAUTION

Engine may be timed while cranking engine with starter motor. To prevent engine from starting when being cranked, all spark plugs must be removed.

1. Insert Spark Gap Tool (91-63998A1) into each spark plug boot and attach alligator clips to good engine ground.
2. Disconnect remote fuel line from engine.
3. Connect remote control electric harness to engine wiring harness.
4. Remove throttle cable barrel from barrel retainer.

IDLE TIMING ADJUSTMENT

1. Connect timing light to No. 1 (TOP) spark plug lead.

⚠ WARNING

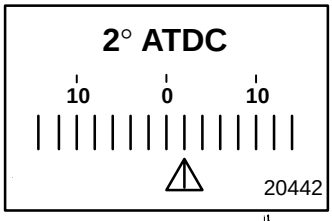
While cranking engine, keep clear of propeller as it may rotate.

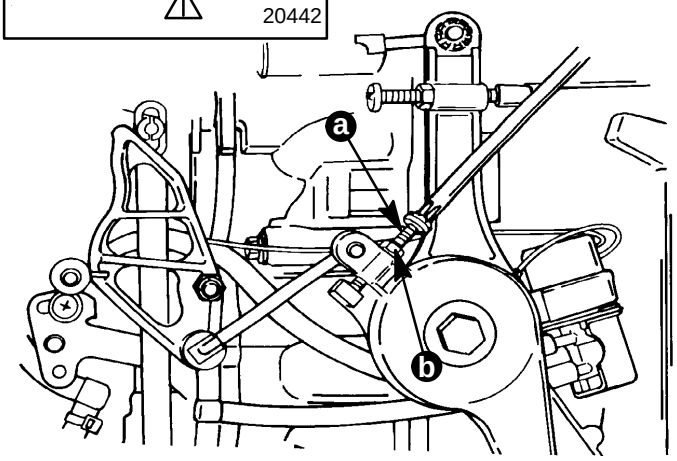
2. Shift engine to neutral.

IMPORTANT: To time engine at cranking speed, a fully charged battery must be used.

3. Hold throttle arm at idle position, crank engine with starter motor and adjust idle timing screw (a) to align 2 degrees ATDC timing mark of flywheel with timing pointer. Tighten locknut (b).

NOTE: Timing will be 2° - 6° ATDC after adjusting idle RPM.

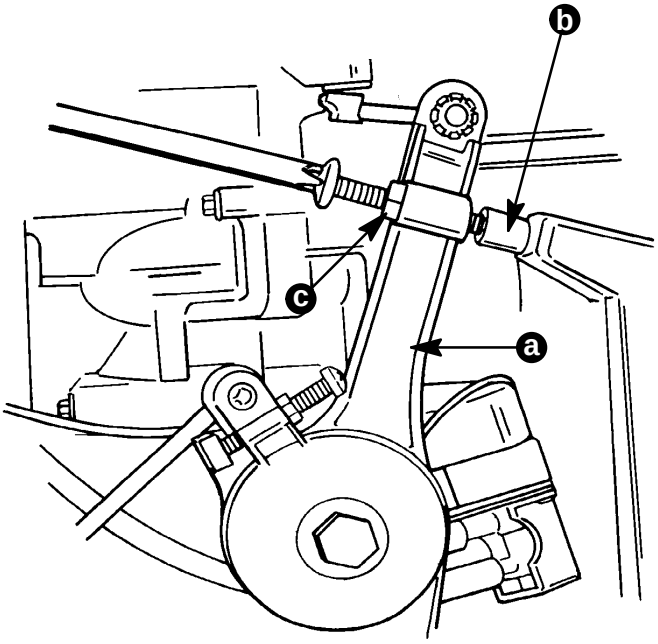




51045

MAXIMUM TIMING

1. Hold control arm (a) so that maximum spark advance screw (b) is against stop. Crank engine with starter motor and adjust maximum spark advance screw to align the specified BTDC timing mark on flywheel with timing pointer. Tighten locknut (c).

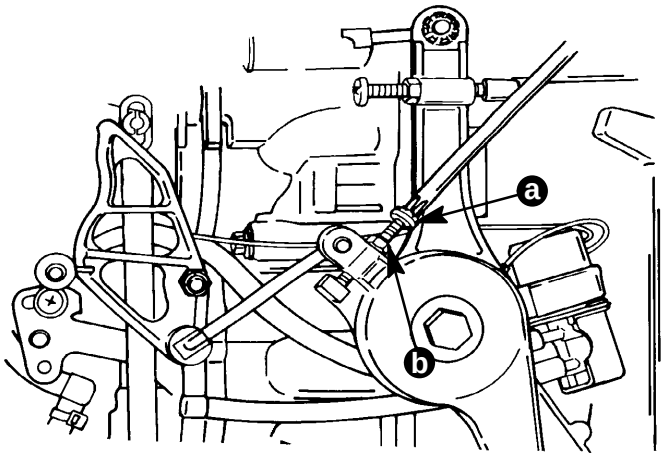


51045

NOTE: All timing adjustments made to engine under cranking speed conditions should be verified with engine running and adjustments made if necessary. This is due to advance characteristics of individual ignition systems.

Idle Adjustment

1. With engine is water, connect electrical harness and fuel line to engine. Start engine and allow to warm up.
2. Properly adjust carburetor low speed mixture screws. Initial setting is 1-1/4 turns off seat.
3. Hold throttle arm at idle position (throttle cable barrel removed from barrel retainer). Adjust idle timing screw (a) to attain an engine idle RPM of 650-750 RPM in "FORWARD" gear. Tighten locknut (b) and turn off engine.



51045

Throttle Cable Installation

1. With end of throttle cable connected to throttle lever, hold throttle lever against idle stop. Adjust throttle cable barrel to slip into barrel retainer on cable anchor bracket with a very light preload of throttle lever against idle stop. Lock barrel in place.

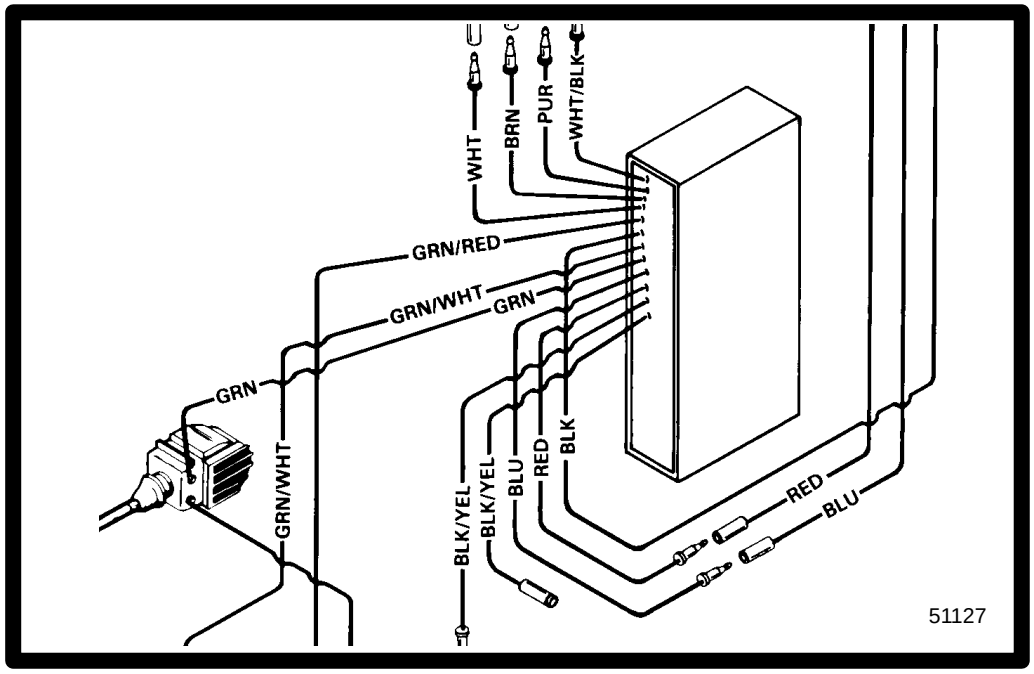
IMPORTANT: Excessive preload on throttle cable will cause difficulty when shifting from forward to neutral. (Re-adjust throttle cable barrel, if necessary.)

2. Check preload on throttle cable by placing a thin piece of paper between idle stop screw and idle stop. Preload is correct when paper can be removed without tearing but has some drag on it. Re-adjust throttle cable barrel, if necessary.

ELECTRICAL AND IGNITION

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D



WIRING DIAGRAMS

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Wiring Diagram
(Regulator Models) 2D-3

Model 50/60 Electric Start Tiller Handle
Wiring Diagram 2D-4

Model 55 Manual Start
Wiring Diagram 2D-5

Model 50/60 Power Trim
Wiring Diagram 2D-6

Model 50/60 Manual Start with RED Stator
Wiring Diagram 2D-7

Model 50/60 Electric Start with RED Stator
Wiring Diagram 2D-8

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Key/Choke Switch Continuity Test
(COMMANDER 2000 Side Mount Remote Control)
Wiring Diagram 2D-9

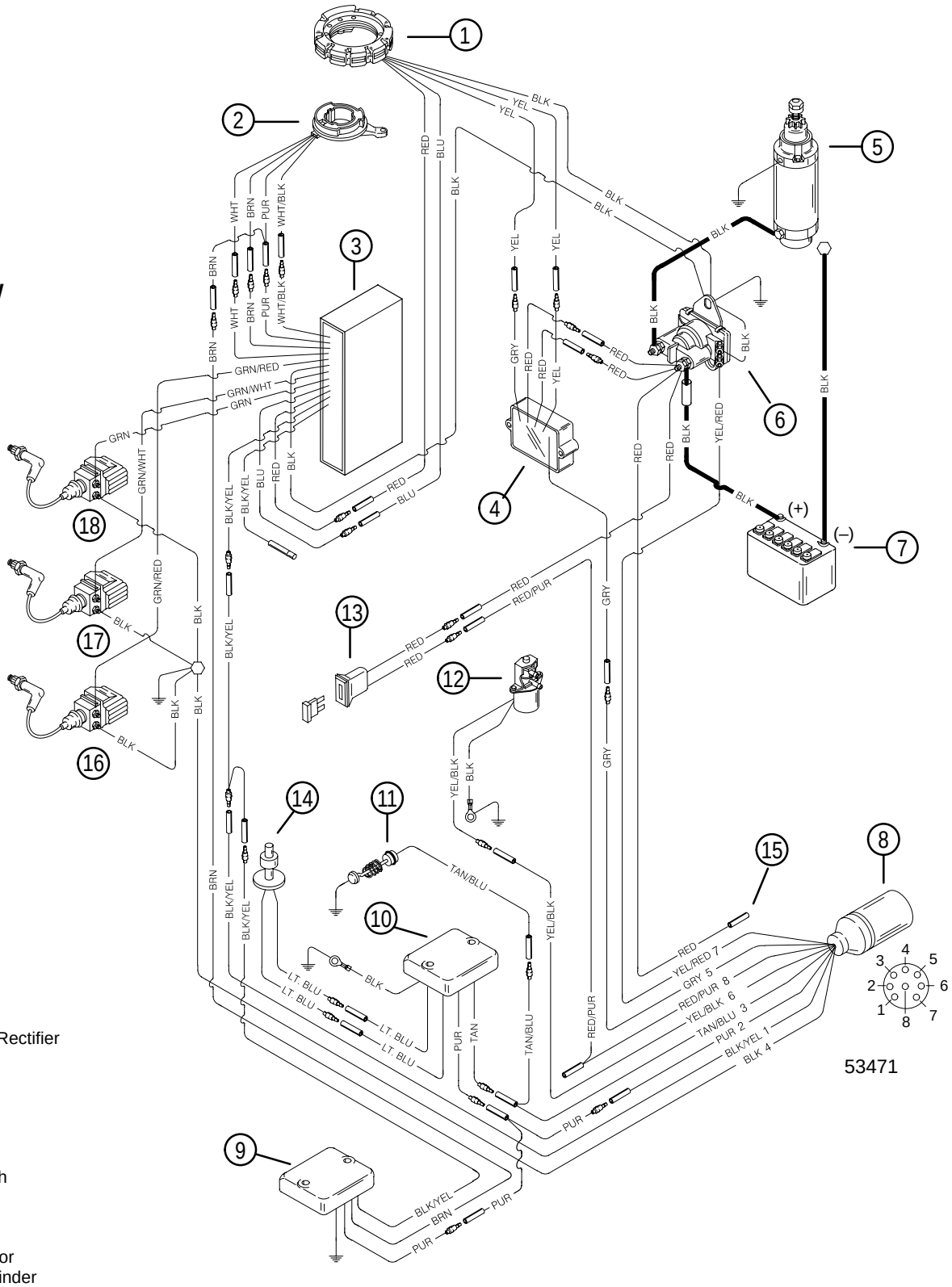
COMMANDER 2000 Side Mount Remote Control
(Power Trim/Tilt Electric Start with Warning Horn)
Wiring Diagram 2D-10

COMMANDER Side Mount Remote Control
(Power Tilt Electric Start with Warning Horn)
Wiring Diagram 2D-11

COMMANDER 2000 Side Mount Remote Control
(Electric Start with Warning Horn)
Wiring Diagram 2D-12

Model 45 Jet Electric Start Wiring Diagram

BLK • BLACK
BLU • BLUE
BRN • BROWN
GRY • GREY
GRN • GREEN
PUR • PURPLE
RED • RED
TAN • TAN
WHT • WHITE
YEL • YELLOW
LIT • LIGHT

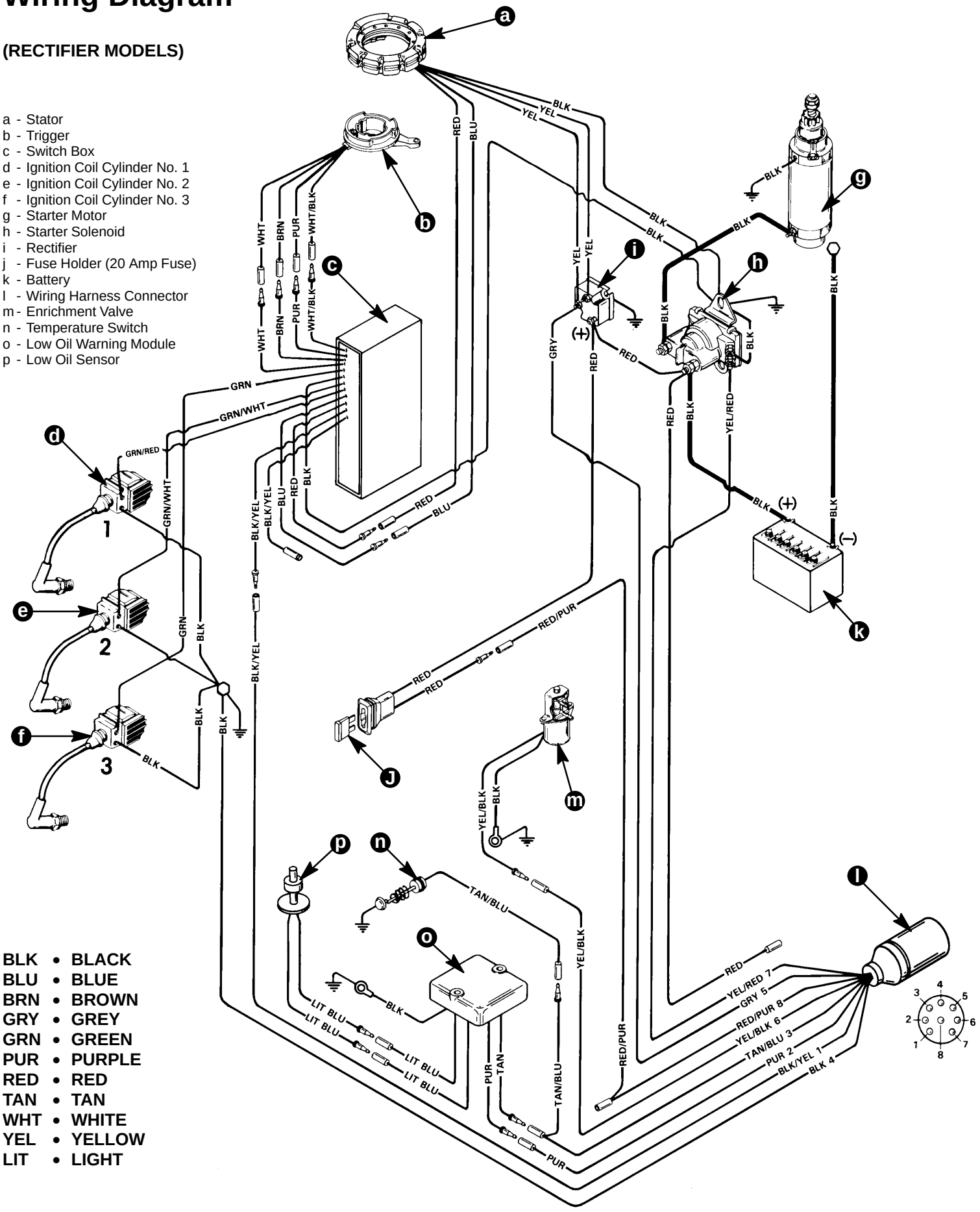


1 - Stator
2 - Trigger
3 - Switch Box
4 - Voltage Regulator/Rectifier
5 - Starter
6 - Starter Solenoid
7 - Battery
8 - Engine Harness
9 - RPM Limiter
10- Warning Module
11- Temperature Switch
12- Enrichment Valve
13- 20 Ampere Fuse
14- Low Oil Sensor
15- To Power Trim Motor
16- Ignition Coil #3 Cylinder
17- Ignition Coil #2 Cylinder
18- Ignition Coil #1 Cylinder

Model 50/60 Electric Start Wiring Diagram

(RECTIFIER MODELS)

a - Stator
b - Trigger
c - Switch Box
d - Ignition Coil Cylinder No. 1
e - Ignition Coil Cylinder No. 2
f - Ignition Coil Cylinder No. 3
g - Starter Motor
h - Starter Solenoid
i - Rectifier
j - Fuse Holder (20 Amp Fuse)
k - Battery
l - Wiring Harness Connector
m - Enrichment Valve
n - Temperature Switch
o - Low Oil Warning Module
p - Low Oil Sensor

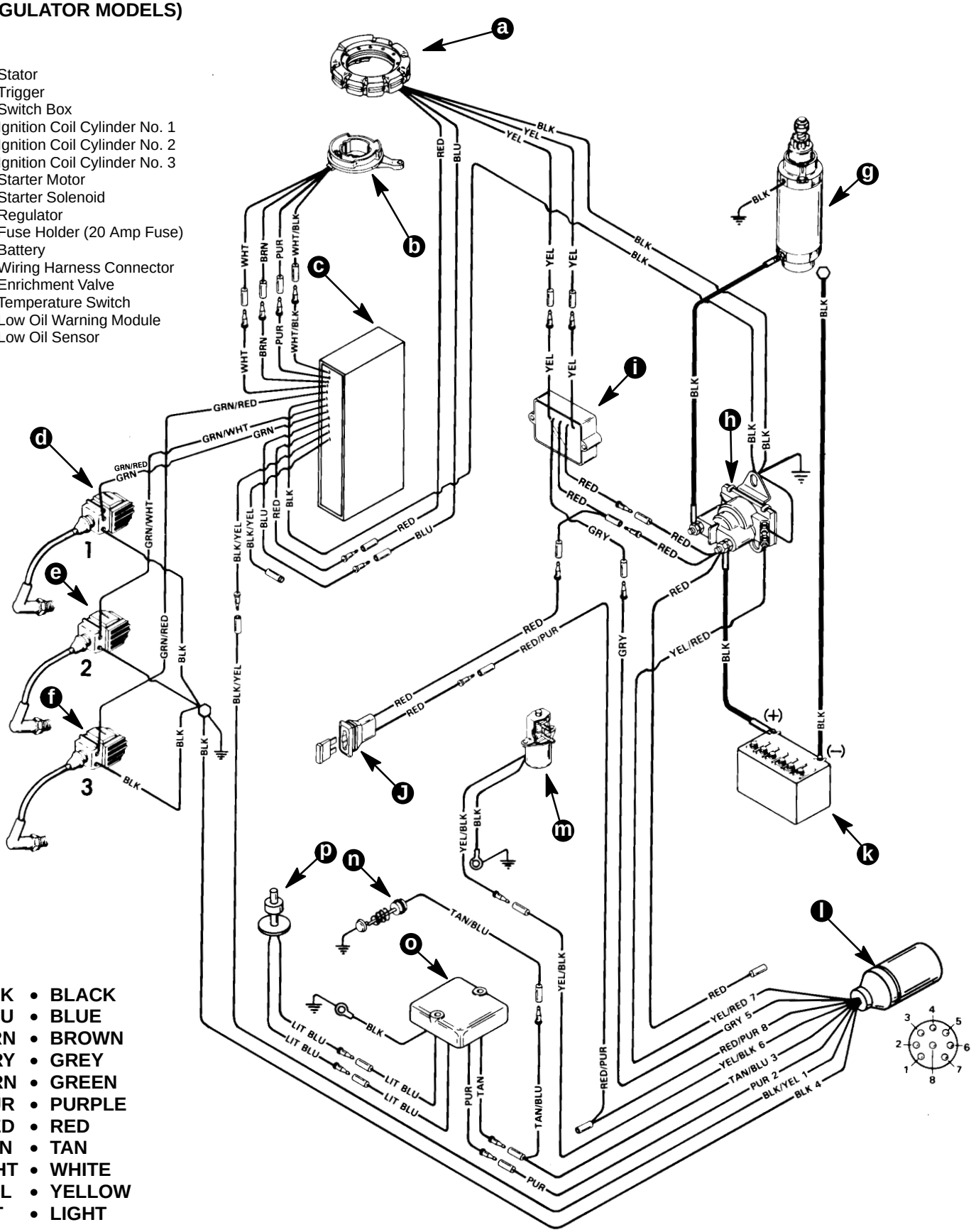


BLK • BLACK
BLU • BLUE
BRN • BROWN
GRY • GREY
GRN • GREEN
PUR • PURPLE
RED • RED
TAN • TAN
WHT • WHITE
YEL • YELLOW
LIT • LIGHT

Model 50/60 Electric Start Wiring Diagram

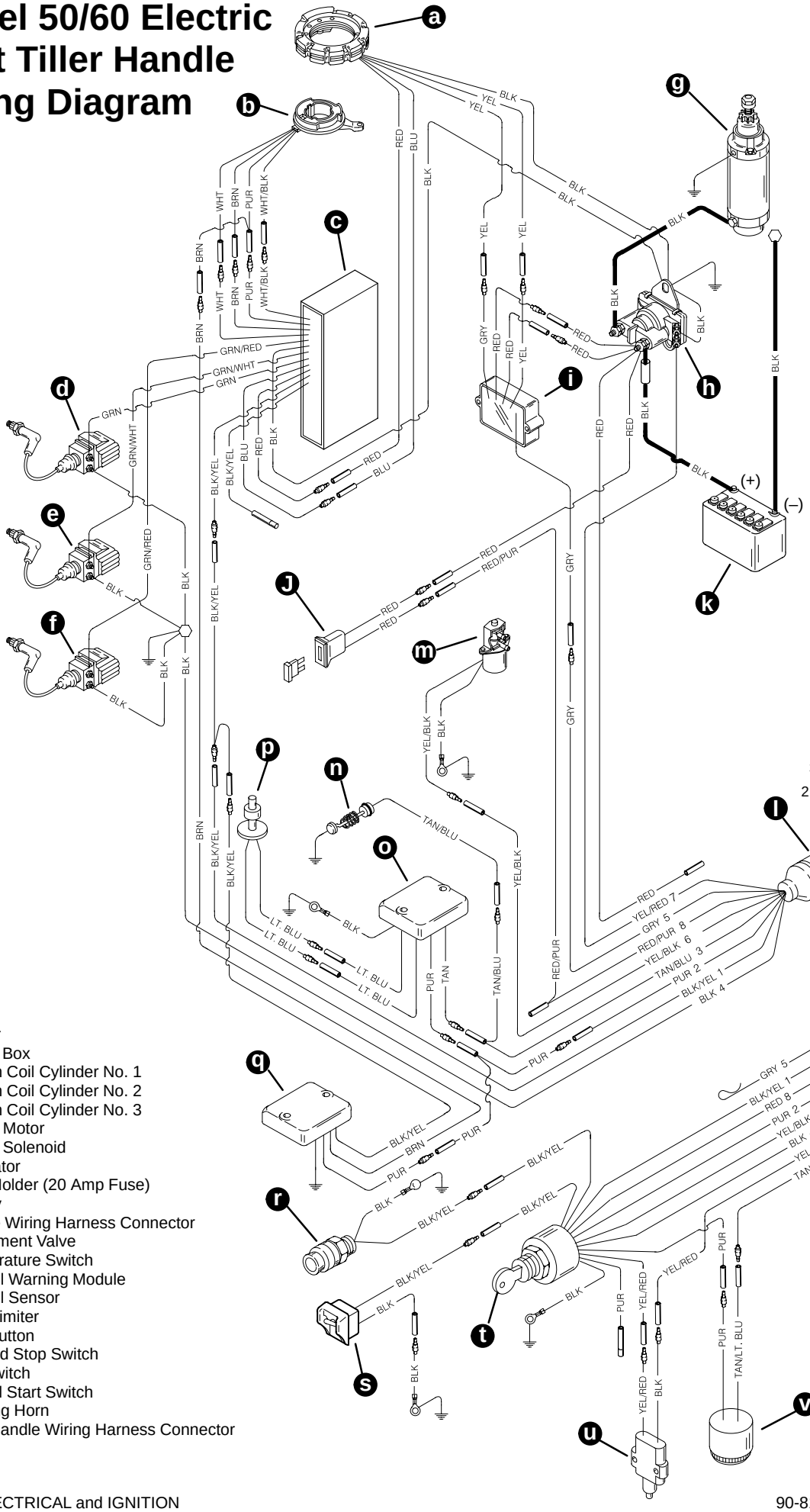
(REGULATOR MODELS)

a - Stator
b - Trigger
c - Switch Box
d - Ignition Coil Cylinder No. 1
e - Ignition Coil Cylinder No. 2
f - Ignition Coil Cylinder No. 3
g - Starter Motor
h - Starter Solenoid
i - Regulator
j - Fuse Holder (20 Amp Fuse)
k - Battery
l - Wiring Harness Connector
m - Enrichment Valve
n - Temperature Switch
o - Low Oil Warning Module
p - Low Oil Sensor



BLK • BLACK
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BRN • BROWN
GRY • GREY
GRN • GREEN
PUR • PURPLE
RED • RED
TAN • TAN
WHT • WHITE
YEL • YELLOW
LIT • LIGHT

Model 50/60 Electric Start Tiller Handle Wiring Diagram

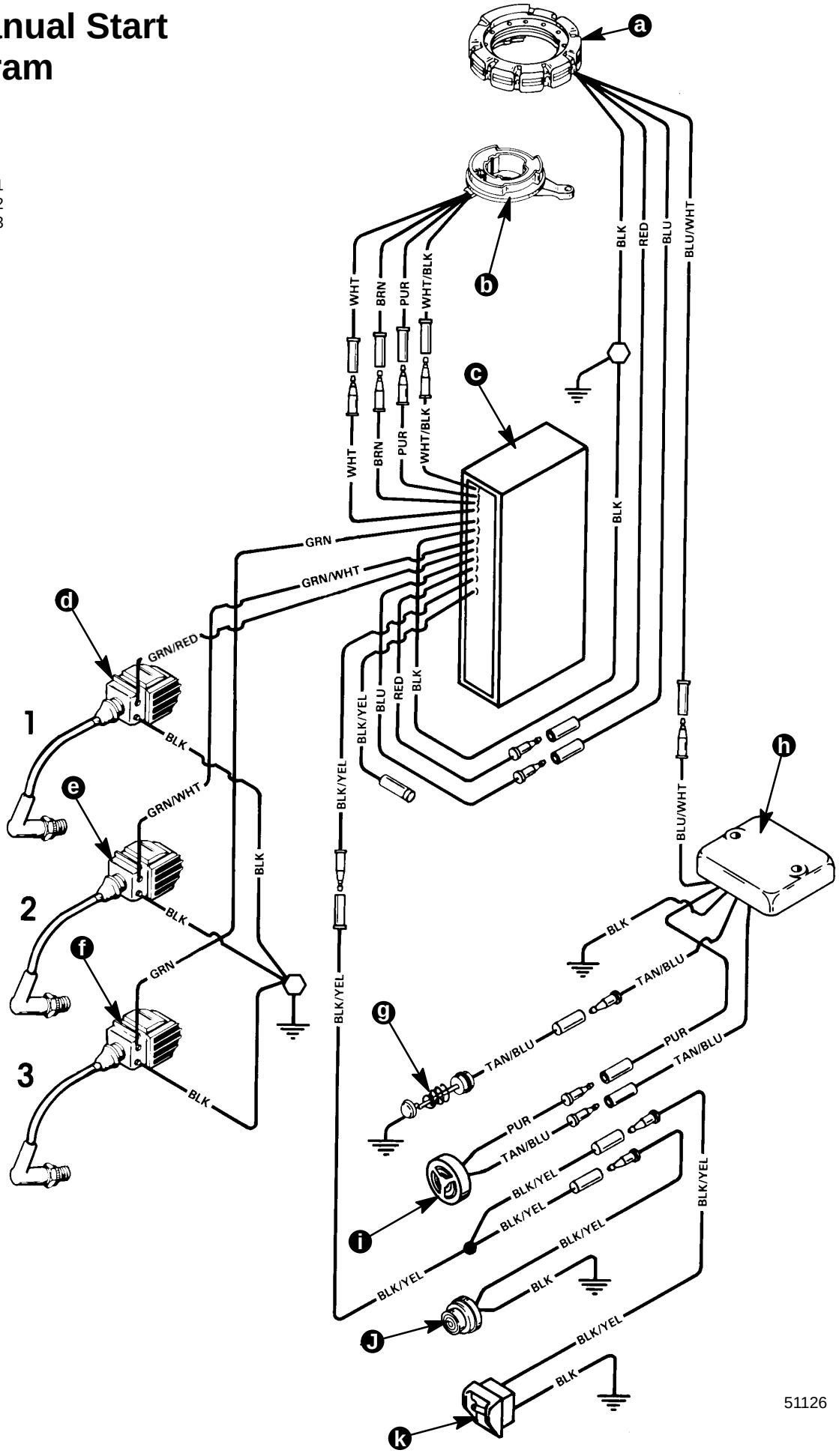


a - Stator
b - Trigger
c - Switch Box
d - Ignition Coil Cylinder No. 1
e - Ignition Coil Cylinder No. 2
f - Ignition Coil Cylinder No. 3
g - Starter Motor
h - Starter Solenoid
i - Regulator
j - Fuse Holder (20 Amp Fuse)
k - Battery
l - Engine Wiring Harness Connector
m - Enrichment Valve
n - Temperature Switch
o - Low Oil Warning Module
p - Low Oil Sensor
q - RPM Limiter
r - Stop Button
s - Lanyard Stop Switch
t - Key Switch
u - Neutral Start Switch
v - Warning Horn
w - Tiller Handle Wiring Harness Connector

Model 55 Manual Start Wiring Diagram

a - Stator
b - Trigger
c - Switch Box
d - Ignition Coil Cylinder No. 1
e - Ignition Coil Cylinder No. 2
f - Ignition Coil Cylinder No. 3
g - Temperature Switch
h - Overheat Warning Module
i - Warning Horn
j - Stop Button
k - Lanyard Stop Switch

BLK • BLACK
BLU • BLUE
BRN • BROWN
GRY • GREY
GRN • GREEN
PUR • PURPLE
RED • RED
TAN • TAN
WHT • WHITE
YEL • YELLOW
LIT • LIGHT

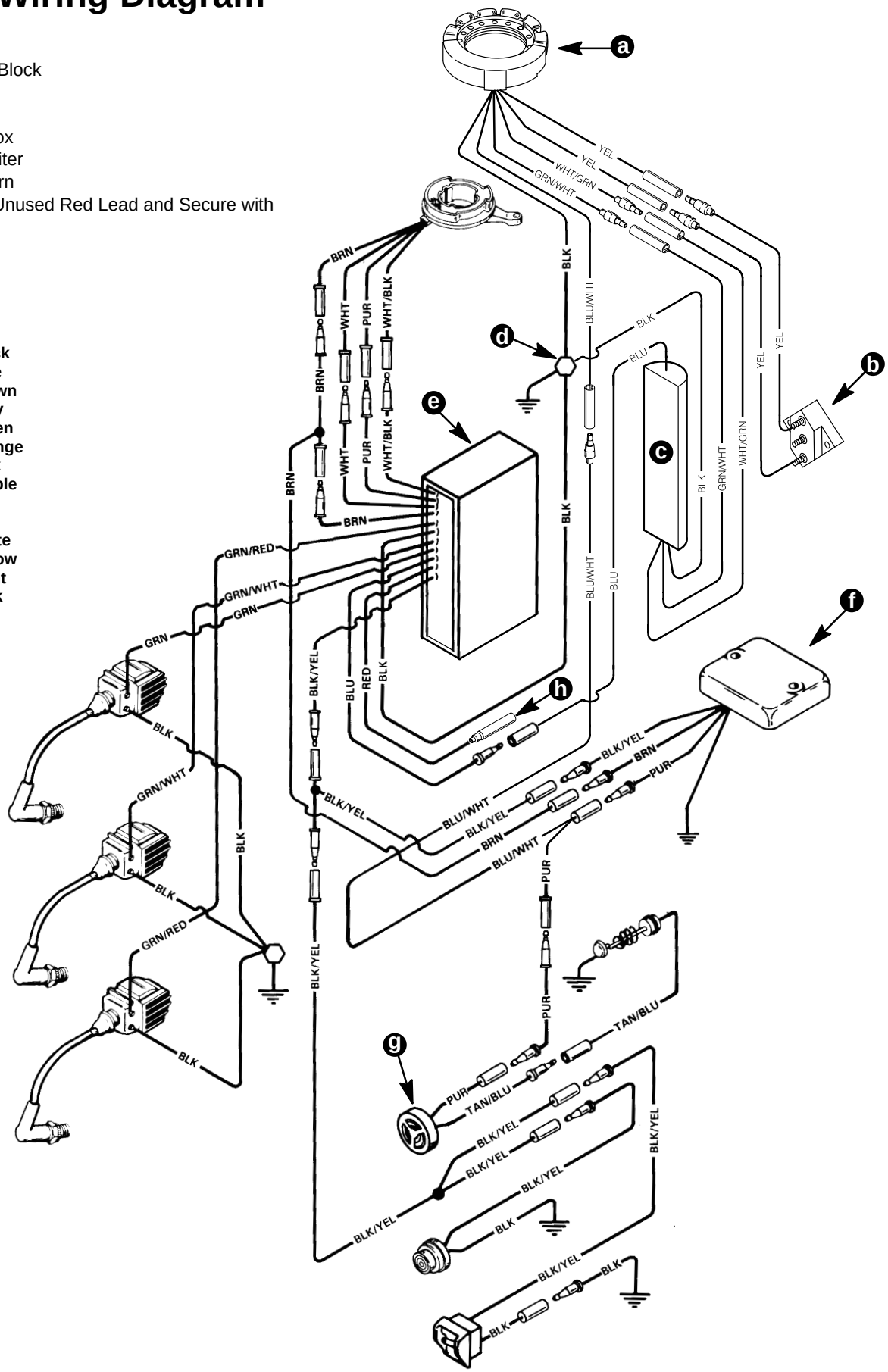


51126

55/60 Manual Start with RED Stator Wiring Diagram

a - Stator
b - Terminal Block
c - Adaptor
d - Ground
e - Switch Box
f - RPM Limiter
g - Audio Horn
h - Insulate Unused Red Lead and Secure with Sta-Strap

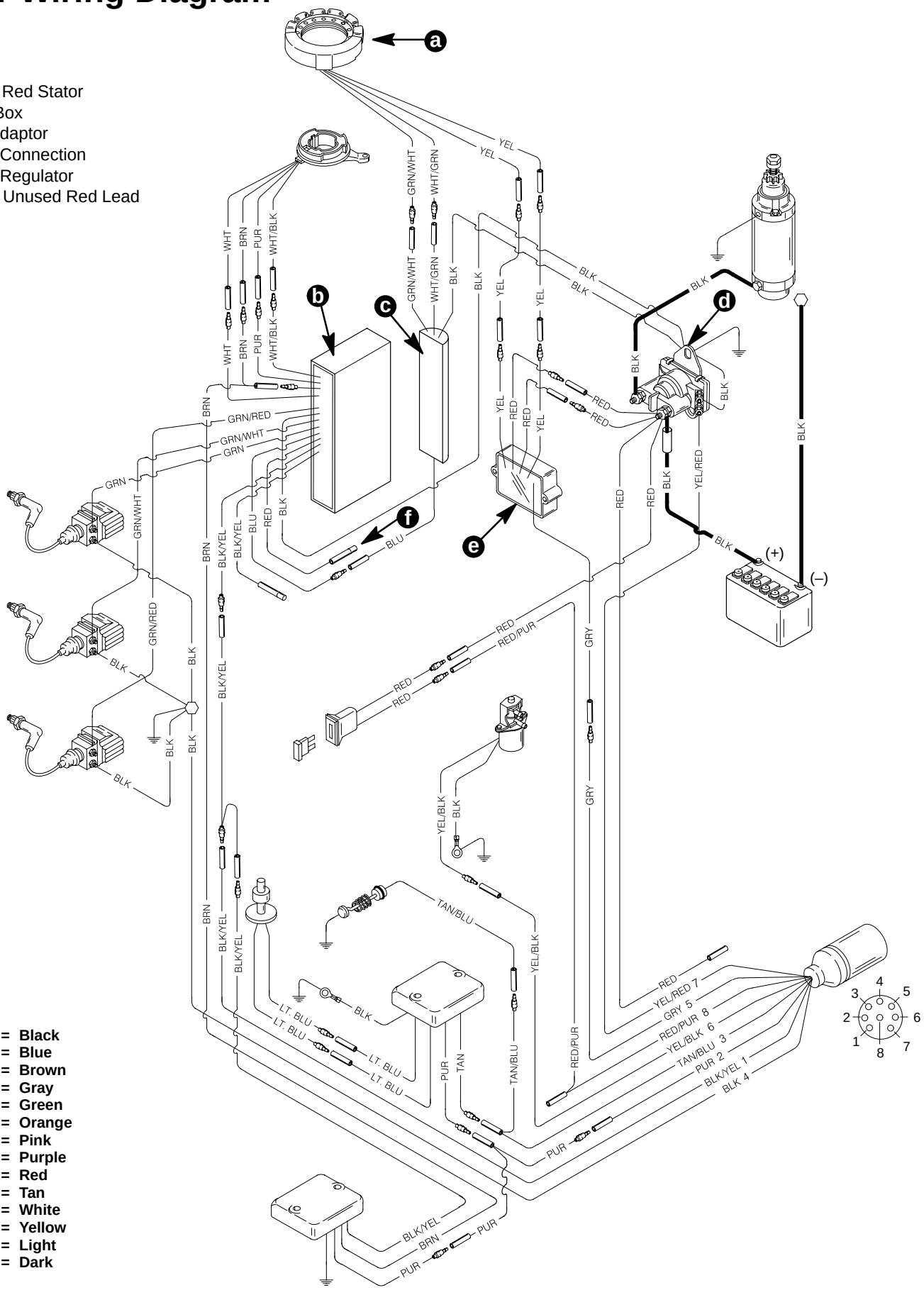
BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT = White
YEL = Yellow
LT = Light
DRK = Dark



54488

50/60 Electric Start with RED Stator Wiring Diagram

a - 16 Amp Red Stator
b - Switch Box
c - Stator Adaptor
d - Ground Connection
e - Voltage Regulator
f - Insulate Unused Red Lead

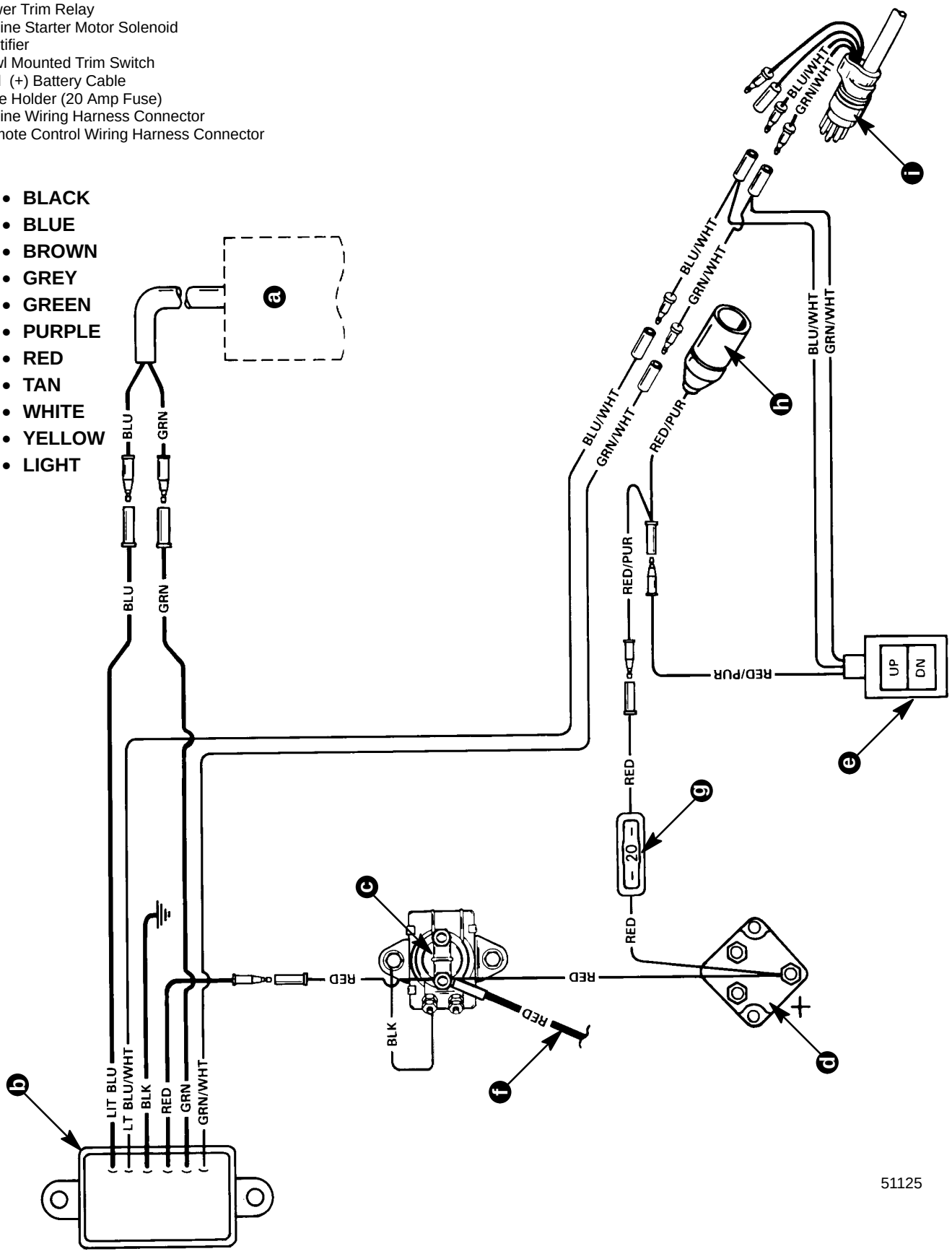


BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT = White
YEL = Yellow
LT = Light
DRK = Dark

Model 50/60 Power Trim Wiring Diagram

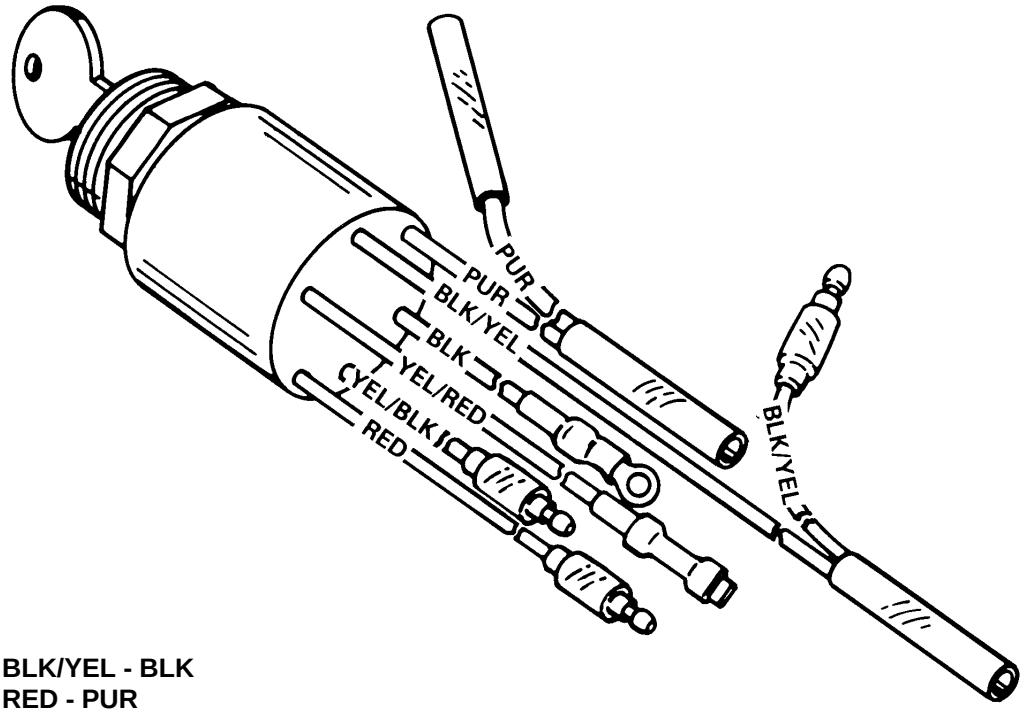
a - Power Trim
b - Power Trim Relay
c - Engine Starter Motor Solenoid
d - Rectifier
e - Cowl Mounted Trim Switch
f - Red (+) Battery Cable
g - Fuse Holder (20 Amp Fuse)
h - Engine Wiring Harness Connector
i - Remote Control Wiring Harness Connector

BLK • BLACK
BLU • BLUE
BRN • BROWN
GRY • GREY
GRN • GREEN
PUR • PURPLE
RED • RED
TAN • TAN
WHT • WHITE
YEL • YELLOW
LIT • LIGHT



51125

Key/Choke Switch Continuity Test (COMMANDER 2000 Side Mount Remote Control)



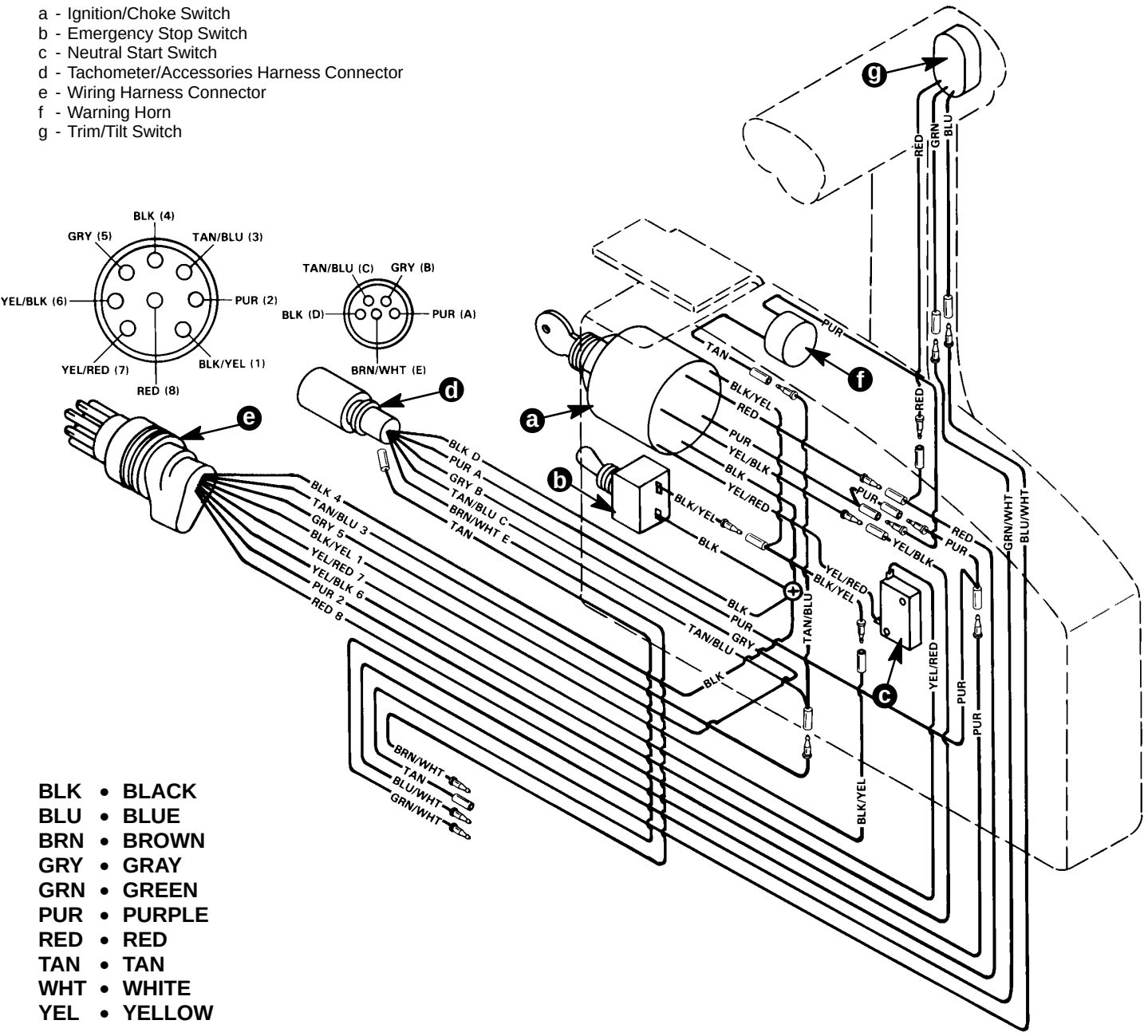
23894

"OFF"	**BLK/YEL - BLK**
"RUN"	**RED - PUR**
"START"	**RED - PUR - YEL/RED**
PUSH (CHOKE)*	**RED - YEL/BLK**

***Key switch must be positioned to "RUN" or "START" and key pushed in to actuate choke, for this continuity test.**

COMMANDER 2000 Side Mount Remote Control (Power Trim/Tilt Electric Start with Warning Horn) Wiring Diagram

a - Ignition/Choke Switch
b - Emergency Stop Switch
c - Neutral Start Switch
d - Tachometer/Accessories Harness Connector
e - Wiring Harness Connector
f - Warning Horn
g - Trim/Tilt Switch



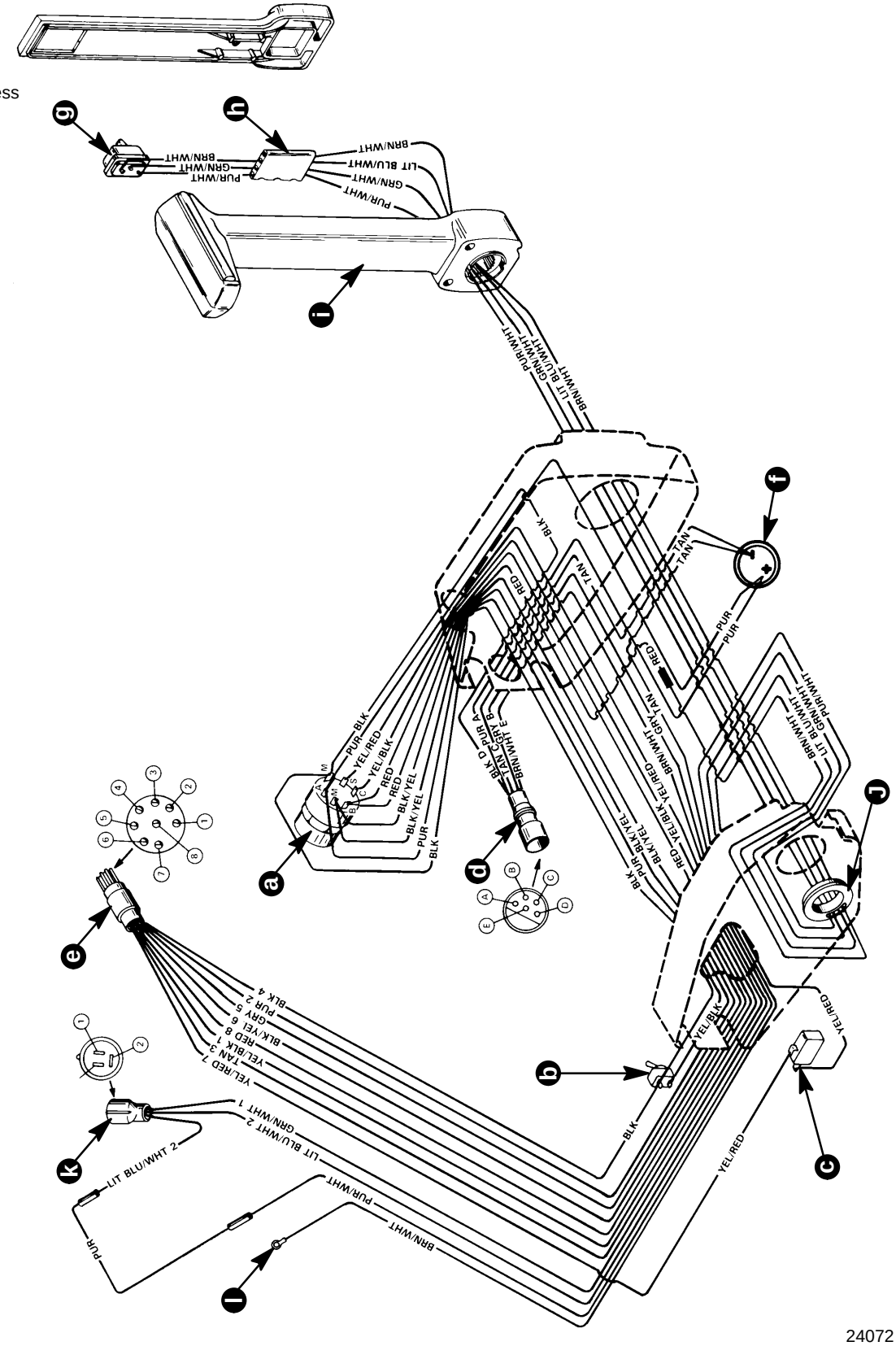
BLK • BLACK
BLU • BLUE
BRN • BROWN
GRY • GRAY
GRN • GREEN
PUR • PURPLE
RED • RED
TAN • TAN
WHT • WHITE
YEL • YELLOW

23891

COMMANDER Side Mount Remote Control (Power Tilt Electric Start with Warning Horn) Wiring Diagram

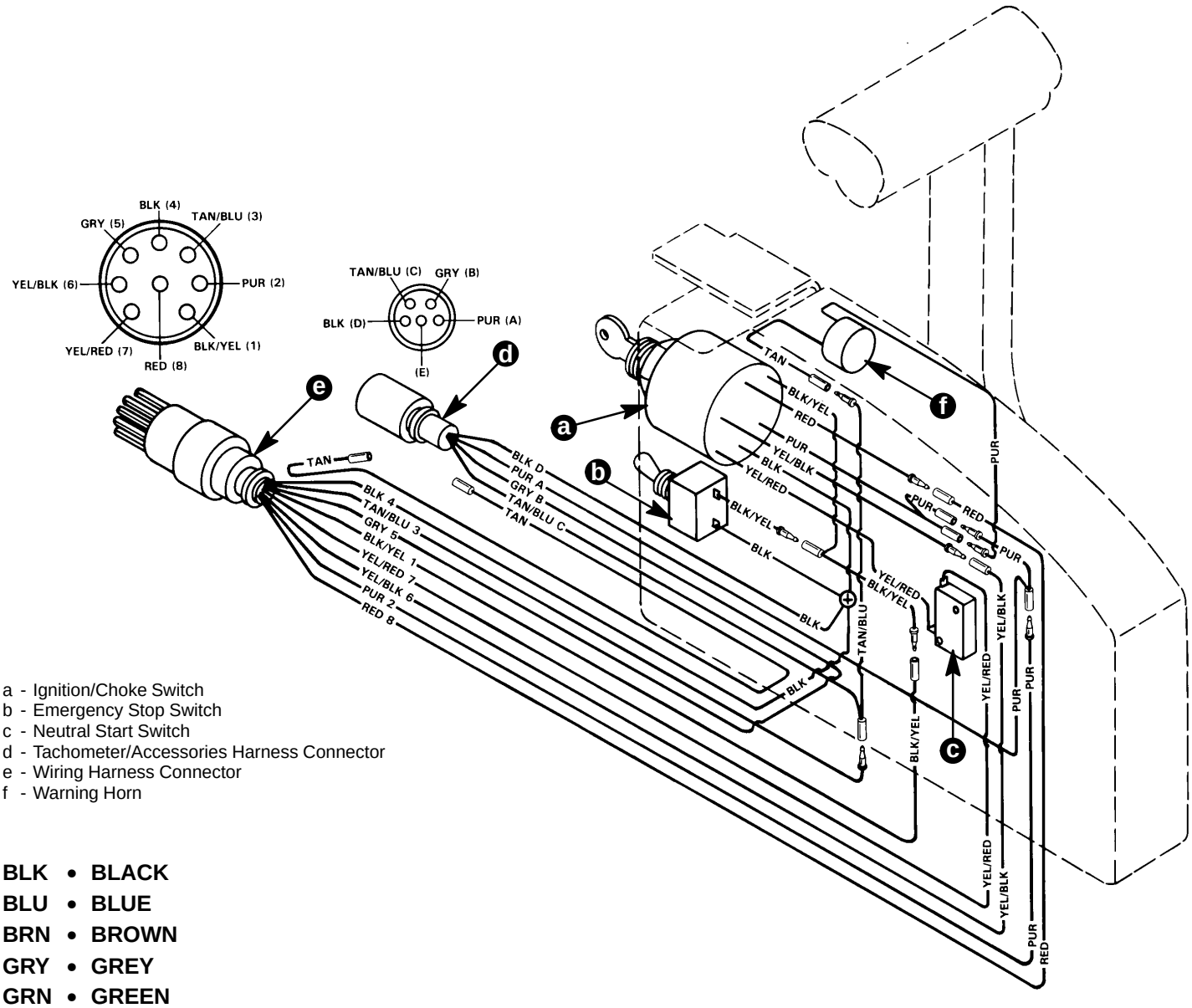
a - Ignition/Choke Switch
b - Emergency Stop Switch
c - Neutral Start Switch
d - Tachometer/Accessories Harness
e - Wiring Harness Connector
f - Warning Horn
g - Trim/Tilt Switch
h - Wire Retainer
i – Control Handle
j - Trim Harness Bushing
k - Trim Harness Connector
l - Lead to Trim Indicator Gauge

BLK • BLACK
BLU • BLUE
BRN • BROWN
GRY • GREY
GRN • GREEN
PUR • PURPLE
RED • RED
TAN • TAN
WHT • WHITE
YEL • YELLOW
LIT • LIGHT



24072

COMMANDER 2000 Side Mount Remote Control (Electric Start with Warning Horn) Wiring Diagram



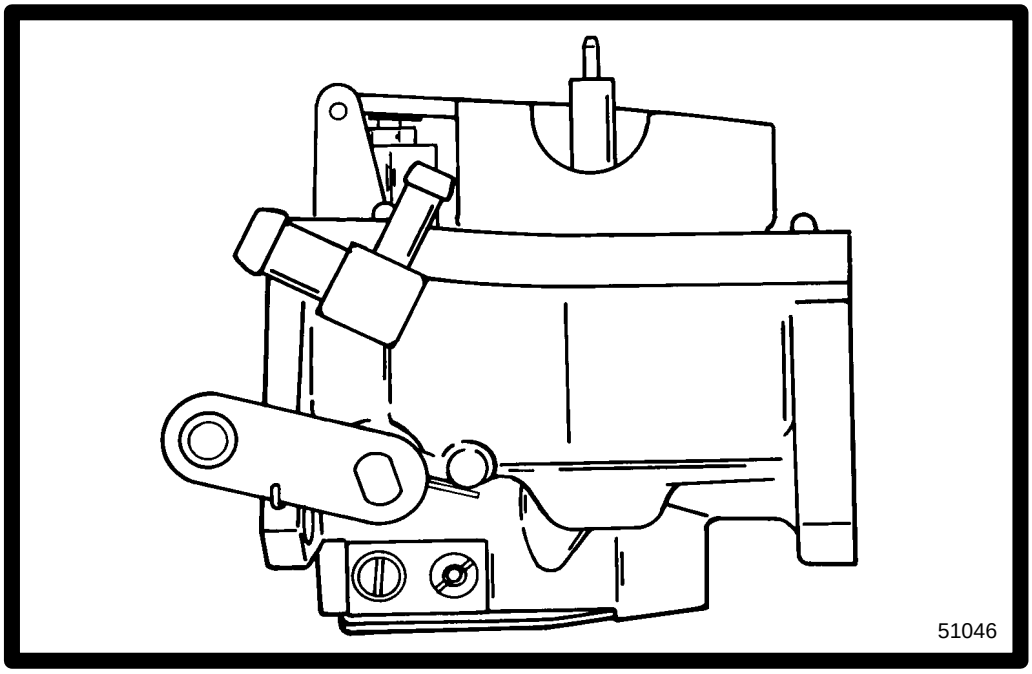
a - Ignition/Choke Switch
b - Emergency Stop Switch
c - Neutral Start Switch
d - Tachometer/Accessories Harness Connector
e - Wiring Harness Connector
f - Warning Horn

BLK • BLACK
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LIT • LIGHT

FUEL SYSTEMS

3

A



CARBURETION

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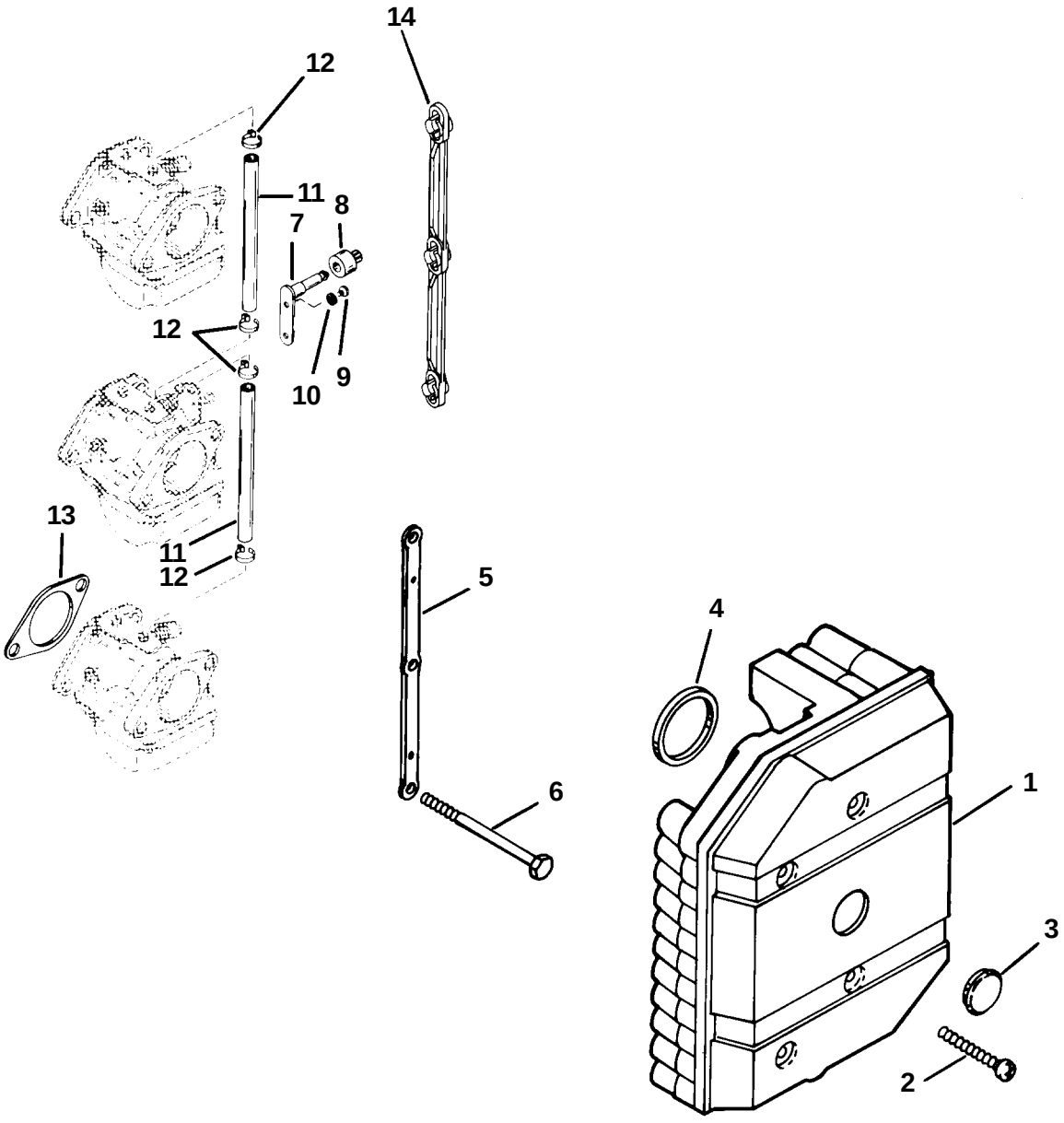
Specifications

Idle RPM (in “Forward” Gear)	650-700
Float Level	9/16 in. (14.3mm)
Fuel Pump Pressure (@ W.O.T.)	4-7 PSI (28-43 kPa)

Special Tools

Part No.	Description
91-36392	Carburetor Scale

Attenuator Plate



Attenuator Plate

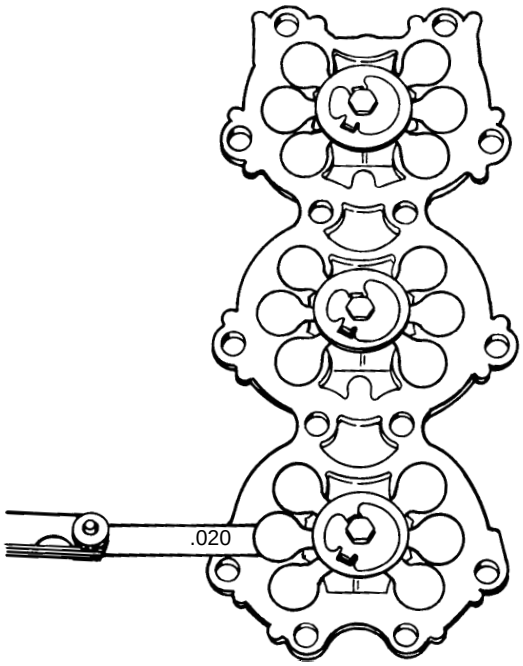
REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	SOUND ATTENUATOR			
2	4	SCREW	Drive Tight		
3	1	CAP PLUG			
4	3	SEAL			
5	2	SOUND ATTENUATOR PLATE			
6	6	SCREW	100		135.5
7	1	ARM			
8	1	ROLLER			
9	1	SCREW	Drive Tight		
10	1	WASHER			
11	2	TUBING (4-1/4 IN.)			
12	AR	STA-STRAP			
13	3	GASKET			
14	1	THROTTLE LINK			

WME Carburetor Specifications

Carburetor Number Stamped at TOP of Carburetor Mounting Flange				
Carburetor Number	Location	Model H.P.	Main Jet	Bowl Vent Jet
WME 43-1 WME 43-2 WME 43-3	Top Carburetor Center Carburetor Bottom Carburetor	50	.048	.090
WME 45-1 WME 45-2 WME 45-3	Top Carburetor Center Carburetor Bottom Carburetor	60	.062	.090
WME 44-1 WME 44-2 WME 44-3	Top Carburetor Center Carburetor Bottom Carburetor	55/60	.060	None

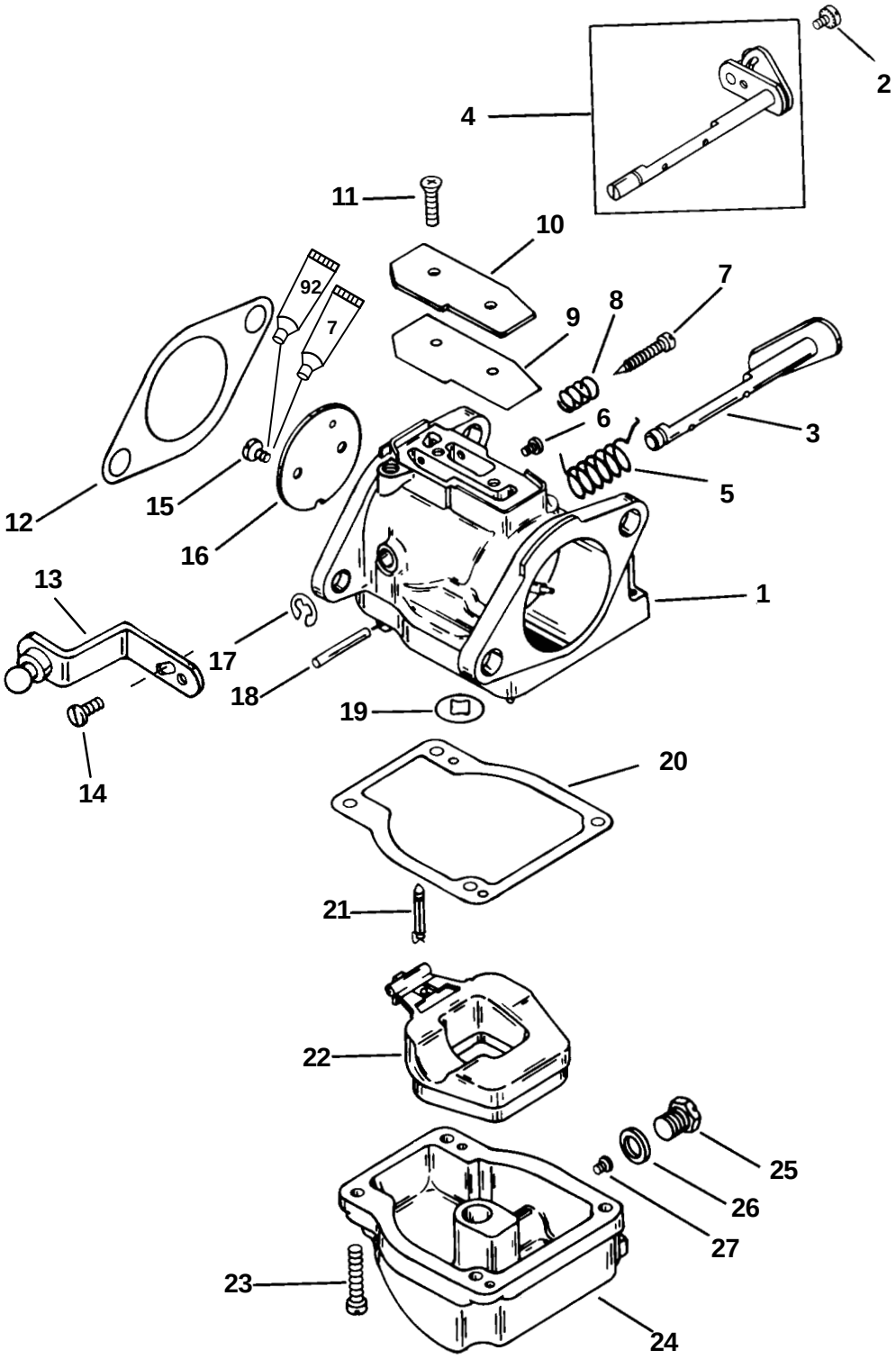
REED VALVE SPECIFICATIONS

Reed Valve Opening (Maximum)
.020 in. (0.5 mm)



Notes:

Carburetor



7 Loctite 271 (92-809820)

92 Loctite 7649 Primer (92-809824)

Carburetor

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	CARBURETOR (**TOP)**			
1	1	CARBURETOR (**CENTER)** **50 - WME-43**			
1	1	CARBURETOR **(BOTTOM)**			
1	1	CARBURETOR (**TOP)** **55/60 SeaPro/Marathon**			
1	1	CARBURETOR **(CENTER)**			
1	1	CARBURETOR **(BOTTOM)** **WME-44**			
1	1	CARBURETOR **(TOP)** **60 - WME-45**			
1	1	CARBURETOR **(CENTER)** **BEACHING/PONTOON/BIG FOOT**			
1	1	CARBURETOR **(BOTTOM)** **FORMULA/MAGNUM III**			
2	2	SCREW–throttle adjustment **(UPPER/BOTTOM)**			
3	1	THROTTLE SHAFT **(UPPER)**			
4	1	THROTTLE SHAFT **(CENTER)** **50/60**			
4	1	THROTTLE SHAFT **(BOTTOM)**			
3	2	THROTTLE SHAFT **(UPPER/BOTTOM)**			
4	1	THROTTLE SHAFT **(CENTER)** **WME-44**			
5	3	SPRING–throttle return			
6	3	VENT JET **(.090 - 50/60)**			
7	3	IDLE NEEDLE			
8	3	SPRING–idle needle			
9	3	GASKET–cover plate			
10	3	COVER PLATE			
11	6	SCREW–cover plate	18		2.0
12	3	GASKET–flange			
13	1	LEVER–oil pump **(WME43/45 - Bottom)**			
14	1	SCREW–oil pump lever **(WME43/45 - Bottom)**			
15	6	SCREW–throttle valve	6		0.7
16	3	THROTTLE VALVE			
17	3	RETAINING RING			
18	3	FLOAT SHAFT			
19	3	GASKET–nozzle well			
20	3	GASKET–fuel bowl			
21	3	INLET NEEDLE VALVE			
22	3	FLOAT			
23	12	SCREW–fuel bowl	18		2.0
24	1	FUEL BOWL **(UPPER)**			
24	2	FUEL BOWL **(CENTER/BOTTOM)**			
25	3	PLUG KIT	25		3.0
26	3	SEAL–bowl drain			
27	3	MAIN FUEL JET **(.048 - 50)**	14		1.5
27	3	MAIN JET **(.060-55/60 SeaPro/Marathon/Pontoon)**	14		1.5
27	3	MAIN FUEL JET **(.062 - 60)**	14		1.5

Carburetion

Fuel System Troubleshooting

Troubles, that are caused by items 1-thru-5, listed below, may give the impression that a problem exists in the fuel system:

1. Spark plugs
2. Ignition spark voltage
3. Cylinder compression
4. Reed valves
5. Ignition timing

Troubleshooting Charts

PROBLEM 1: ENGINE TURNS OVER BUT WILL NOT START OR STARTS HARD WHEN COLD	
Possible Cause	**Corrective Action**
Improper starting procedure	Check procedure, as outlined in “Operation and Maintenance Manual.”
Fuel tank empty; improperly mixed fuel; contaminants (water, dirt, etc.) in fuel.	Check fuel in fuel tank and replace or add.
Fuel tank air vent closed or restricted.	Air vent must be open and free from contaminants.
A pinched or restricted fuel line.	Check, and replace as needed.
Dirty or restricted fuel filter	Check, replace or clean.
Enrichener Valve not operating.	Check enrichener system. (Refer to “Enrichener System” following.)
An inlet needle (in carburetor) that is stuck open or closed. (A needle stuck open, will cause a flooding condition. A needle stuck closed, will prevent fuel from entering carburetor.)	Remove, clean, or replace.
Anti-Siphon valve restricting fuel flow.	Refer to “Checking for Restricted Fuel Flow caused by Anti-Siphon Valves”, following.

See “Checking for Restricted Fuel Flow caused by Anti-Siphon Valves, page 3A-13.

PROBLEM: ENGINE FLOODS	
Possible Cause	**Corrective Action**
Dirt or foreign particles are preventing inlet needle from seating.	Flush out inlet seat and clean inlet needle.
Worn inlet needle.	Replace.
Punctured float.	Replace.
Incorrect float setting.	Reset float.

PROBLEM: ENGINE RUNS TOO LEAN	
Possible Cause	**Corrective Action**
Carburetor is loose. Air leaks past mixing chamber cover.	Tighten bolts securely. Tighten cover or replace gasket.
Fuel level too low.	Reset float level.
Clogged high speed jet.	Check and clean.
Restricted fuel flow to carburetor.	Check fuel lines and filter(s) for restricted flow.
Incorrect high speed jet.	Refer to main jet chart and replace with proper jet.
Idle mixture set too lean.	Adjust to run richer.
Air leakage into fuel system.	Check fuel line connections, hose clamps, fuel pump, and fuel outlet tube (located in fuel tank) for loose fittings.
Anti-Siphon valve restricting fuel flow.	Refer to “Checking for restricted fuel flow caused by Anti-Siphon valves.”

PROBLEM: ENGINE RUNS TOO RICH	
Possible Cause	**Corrective Action**
Fuel level too high.	Reset float to correct level.
Carburetor floods.	See preceding “Engine Floods”
Idle nozzle air holes plugged.	Blow out with compressed air.
Restricted air flow.	Check cowl air inlet and carburetor for obstructions.
Main Fuel Jet loose.	Retighten Jet.

PROBLEM 1: ENGINE IDLES ROUGH AND STALLS	
PROBLEM 2: ENGINE RUNS UNEVEN OR SURGES	
PROBLEM 3: ENGINE WILL NOT ACCELERATE	
Possible Cause	**Corrective Action**
Fuel tank air vent closed or restricted.	Check - Air vent must be open all-the-way and free from restrictions.
A pinched, cut or restricted fuel line; also loose fuel line connection.	Check all fuel lines and replace as needed. Check and tighten all fuel line connections.
A dirty or restricted fuel filter.	Check, replace, or clean all fuel filters.
Restricted filter in fuel tank.	Clean by rinsing in clean lead-free gasoline or kerosene.
Improperly mixed fuel; contaminants (water, dirt, etc,) in fuel.	Check fuel and replace, if necessary.
An inlet needle (in carburetor) that is either stuck open or closed. (A needle, that is stuck open, will cause a flooding condition. A needle, that is stuck closed, will prevent fuel from entering carburetor.)	Remove and replace with new inlet needle.
Incorrect idle mixture adjustment.	Re-adjust.
Damaged fuel pump diaphragm.	Replace.
Carburetor is loose.	Tighten bolts securely.
Chamber cover leaking air.	Tighten or replace gasket.
Off idle holes plugged.	Blow out with compressed air.
Main nozzle or idle nozzle air bleed holes plugged.	Blow out with compressed air.
Improper main jet or restricted jet.	Clean or replace with proper jet (refer to “Main Jet Chart”).
Damaged reed(s).	Inspect reeds as outlined in Section 4A.
A crack in the fuel pick-up outlet tube (located in fuel tank).	Replace.

PROBLEM 1: ENGINE IDLES ROUGH AND STALLS	
PROBLEM 2: ENGINE RUNS ENEVEN OR SURGES	
PROBLEM 3: ENGINE WILL NOT ACCELERATE.	
Possible Cause	**Corrective Action**
A crack in the fuel outlet tube (located in fuel tank.)	Replace.
Anti-Siphon valve restricting fuel flow.	Refer to “Checking for Restricted Fuel Flow Caused by Anti-Siphon Valves,” following.

PROBLEM : FUEL BLOW-BACK OUT OF CARBURETOR	
Possible Cause	**Corrective Action**
Chipped/Broken (reed-block) Reeds	Replace Reeds.
PROBLEM : ROUGH IDLE	
If related to reed-block, indicates excessive preload in reeds.	Replace Reeds.
PROBLEM : CAN’T REDUCE ENGINE RPM TO SLOW IDLE	
Multiple chipped reeds	Replace Reeds.

CHECKING FOR RESTRICTED FUEL FLOW CAUSED BY ANTI-SIPHON VALVES

While anti-siphon valves are helpful from a safety standpoint, they clog, they may be too small, or they may have too heavy a spring. The pressure drop across these valves can, create operational problems and/or powerhead damage by restricting fuel. Some symptoms of restricted (lean) fuel flow, are:

1 - Loss of fuel pump pressure
2 - Loss of power
3 - High speed surging
4 - Preignition/detonation (piston dome erosion)
5 - Outboard cuts out or hesitates upon acceleration
6 - Outboard runs rough
7 - Outboard quits and cannot be restarted
8 - Outboard will not start
9 - Vapor lock

Any type of anti-siphon device must be located between the outboard fuel inlet and fuel tank outlet. A method of checking [if such a device (or bad fuel) is a problem source] is to operate the outboard with a separate fuel supply which is know to be good.

If, it is found that the anti-siphon valve is the cause of the problem, either 1) replace the anti-siphon valve or 2) replace it with a solenoid-operated fuel shutoff valve.

Carburetor Adjustments

INITIAL STARTING ADJUSTMENT

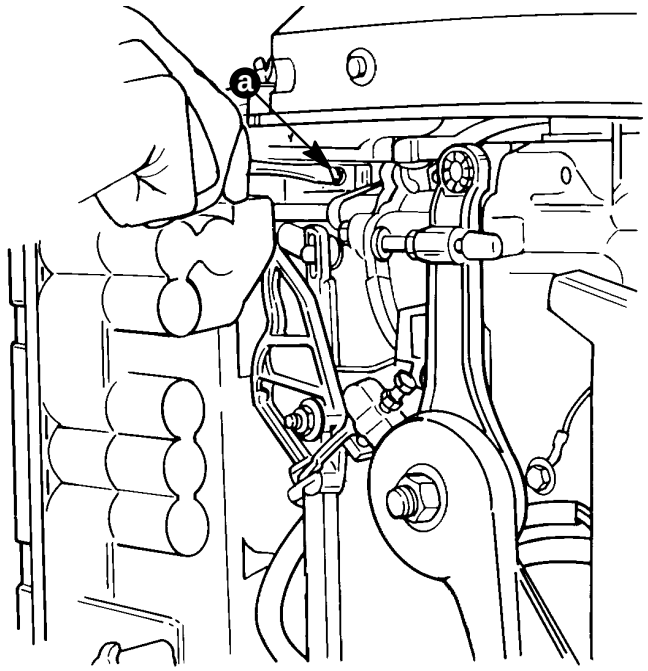
Turn idle mixture screw in (clockwise) until it seats LIGHTLY--then back-off (each carburetor) 1-1/4 turns.

IDLE SEED ADJUSTMENT

1. Adjust engine idle RPM as outlined in Section 2C "Timing/Synchronizing/Adjusting."

IDLE MIXTURE SCREW ADJUSTMENT

1. Start engine and allow to warm-up. Throttle back engine to idle for about one minute.
2. With engine running at idle speed in "Forward" gear -- turn idle mixture screw IN (clockwise) until engine starts to "bog" down and misfire. Back out 1/4 turn or more.



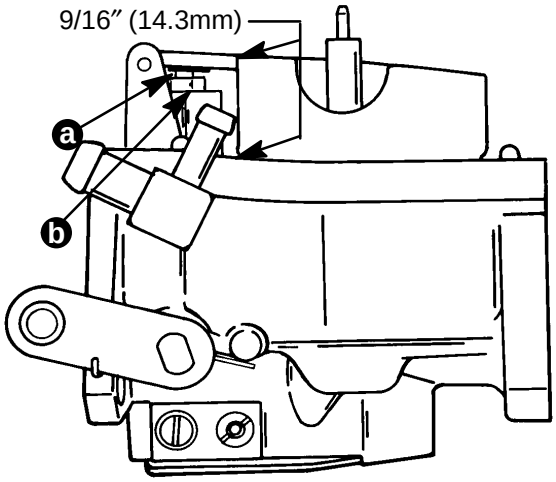
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a - Idle Mixture Screw (on each carburetor)

3. Check for too lean mixture on acceleration.
4. DO NOT adjust leaner than necessary to attain reasonably smooth idling. When in doubt, stay on the slightly rich side of the adjustment.

CARBURETOR FLOAT ADJUSTMENT

1. Remove carburetor as outlined in "Carburetor Removal," following.
2. Remove fuel bowl and gasket and check float level using a carburetor scale.
3. If necessary, adjust float level by bending metal tab (on float) to which inlet needle is clipped.

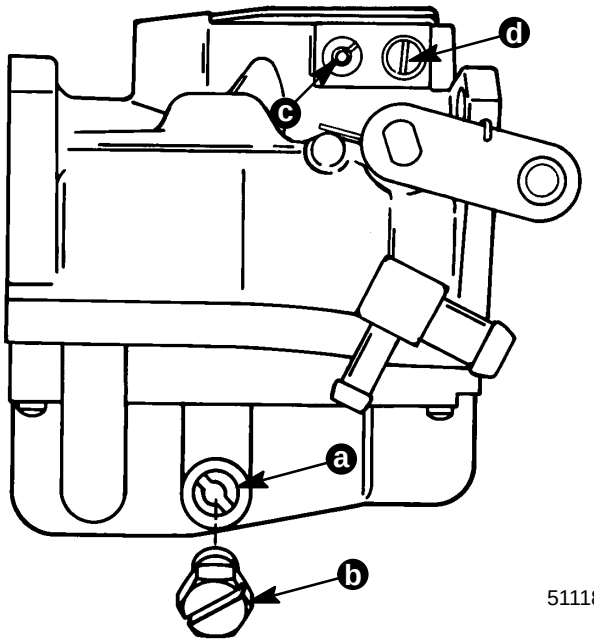


51046

a - Metal Tab
b - Inlet Needle

MAIN (HIGH SPEED) JET ADJUSTMENT

The carburetor has a fixed high speed jet. Extreme changes in weather (temperature and humidity) and/or elevation may result in a too lean or rich fuel mixture at wide-open-throttle, which may require a change in the high speed jet. A smaller size main jet will lean the fuel mixture, and a larger size jet will enrich the fuel mixture.



51118

a - High Speed Jet
b - Bowl Drain Plug
c - Bowl Vent Jet
d - Idle Mixture Screw

WME Carburetor Specifications

Carburetor Number Stamped at TOP of carburetor mounting flange.			
Carburetor Number	Model H.P.	Main Jet	Bowl Vent Jet
WME-23	50	.052	.092
WME-26	50	.048	.090
WME-27	55	.060	None
WME-22 A or B	60	.070	.090
WME-35	60	.068	None
WME-28	60	.062	.090
WME-43	50	.048	.090
WME-44	55/60	.060	None
WME-45	45/60	.062	.090

REJETTING CARBURETORS FOR HIGH ALTITUDE OPERATION

The carburetor jet installed at the manufacturer is for engine operation at sea level through an elevation of 2500 feet (762m) above sea level. If the engine is to be operated at an altitude higher than 2500 feet above sea level, it will be necessary to rejet (remove the carburetor jets and install jets with a different orifice size) the carburetors. Each time the engine is to be operated at a different elevation from the previous time, refer to the "Carburetor Jet Charts" following, and rejet the carburetors for elevation engine will be operated at.

HIGH ALTITUDE JET CHART	
Engine Operation Elevation (Above Sea Level)	**High Speed Jet Size**
2500'-5000' (750-1500m)	.002" smaller (than standard jet)
5000'-7500' (1500-2250m)	.004" smaller (than standard jet)
7500' and Up (2250m and Up)	.006" smaller (than standard jet)

*Standard Jets listed are for operation of engine from 0 ft. – 2500 ft. (0–762 M) of elevation.

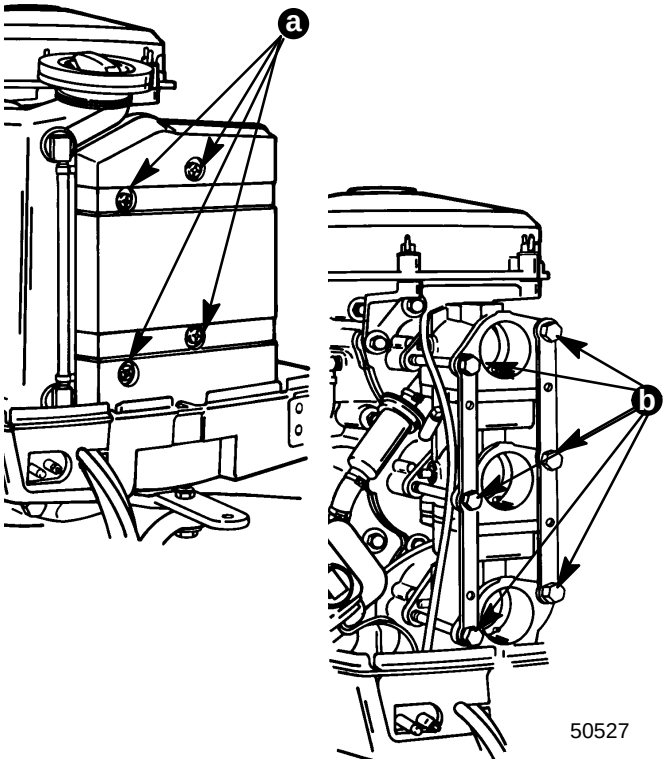
JET ORIFICE SIZE/PART NUMBER CHART

NOTE: *Thread size for jets is 10-32.*

JET ORIFICE SIZE/PART NUMBER CHART			
Jet Orifice Size (inch)	**Part Number**	**Jet Orifice Size (inch)**	**Part Number**
.040	19266040	.058	1395-7831
.042	1399-5315	.060	1395-6487
.044	1395-7394	.062	1399-4217
.046	1399-5317	.064	1399-4216
.048	1395-6246	.066	1399-4215
.050	1395-6028	.068	1395-6029
.052	1395-6359	.070	1395-6030
.054	1399-5225	.072	1395-6207
.056	1399-5213	.074	1399-3794
.076	1399-3796	.094	1395-8423
.078	1395-6680	.096	1399-6249
.080	1395-6201	.098	1395-7335
.082	1399-3518		
.084	1399-3517		
.086	1395-5815		
.088	1395-6202		
.090	1395-6247		
.092	1395-5733		

Carburetor Removal

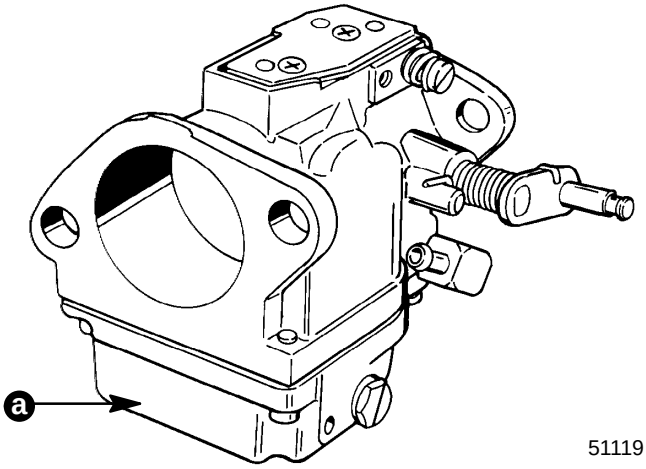
- Remove four screws and lift off attenuator.
- Remove six screws and remove carburetors. Disconnect linkages and fuel and primer lines.



a - Attenuator Screw (4)
b - Carburetor Screw (6)

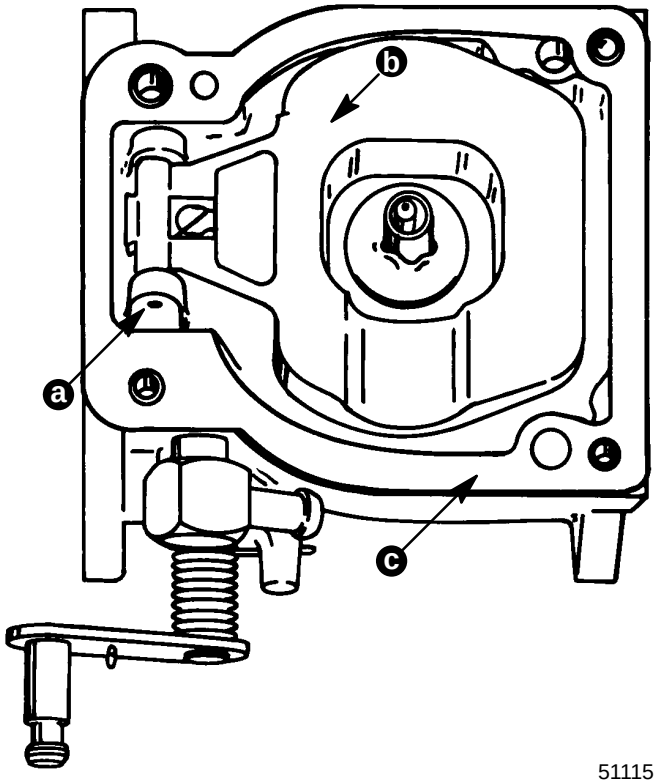
Carburetor Disassembly

- Remove fuel bowl.



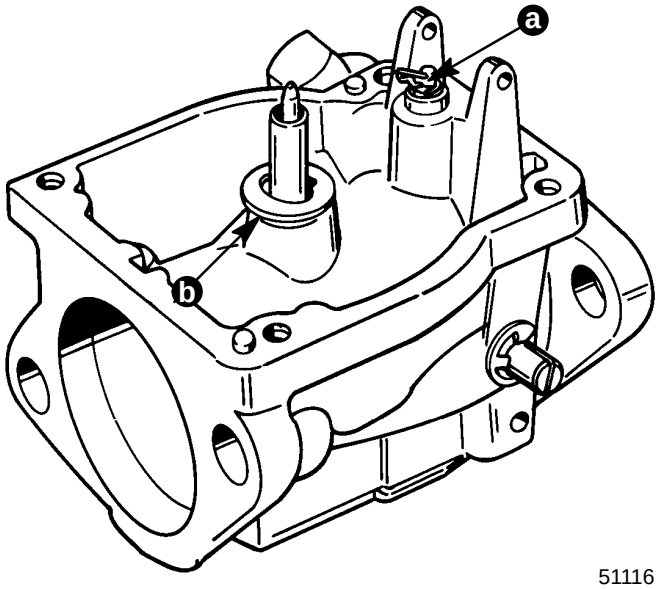
a - Fuel Bowl

- Remove float pin and remove float.
- Remove fuel bowl gasket.



a - Float Pin
b - Float
c - Gasket

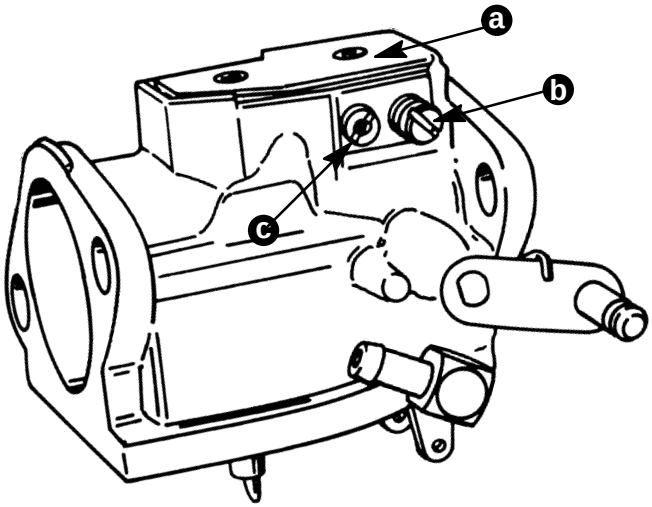
- Remove fuel inlet needle.
- Remove stem gasket.



51116

a - Fuel Inlet Needle
b - Stem Gasket

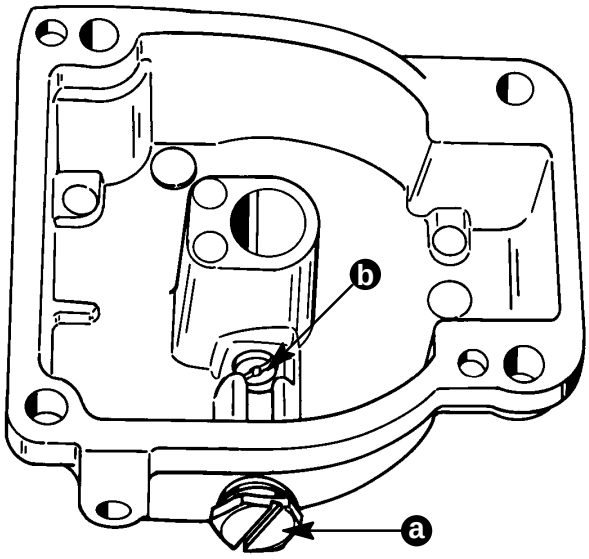
- Remove mixing chamber cover and gasket.
- Remove idle mixture screw.
- Remove bowl vent jet



51116

a - Mixing Chamber Cover and Gasket
b - Idle Mixture Screw
c - Bowl Vent Jet

- Remove main jet plug and gasket.
- Remove main jet.

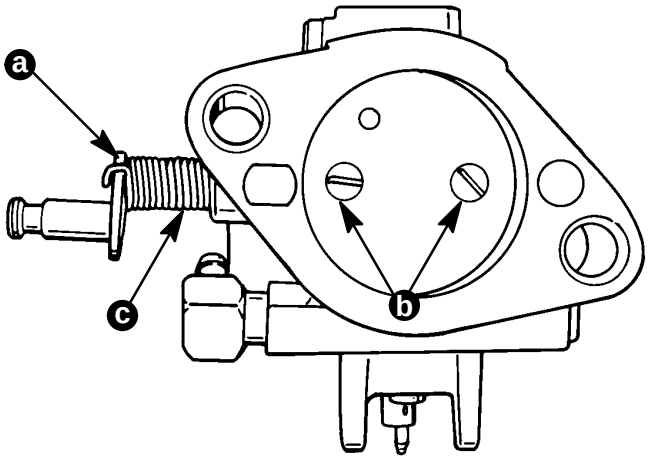


51116

a - Main Jet Plug and Gasket
b - Main Jet

NOTE: *It is not necessary to disassemble carburetor beyond this point for cleaning. Examine throttle shaft for wear and inspect for damaged throttle shutter plate.*

If removal of throttle shaft and/or throttle shutter plate is necessary, remove 2 screws, which secure throttle shutter plate to throttle shaft. Remove retaining clip from end of throttle shaft, then pull shaft out of carburetor.



51117

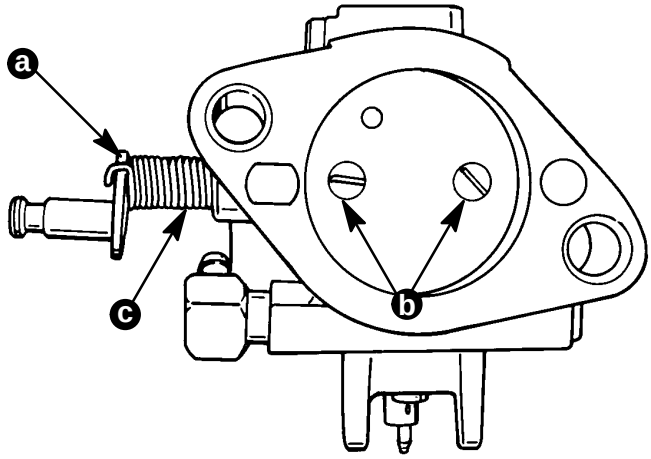
a - Throttle Shaft
b - Screw (2)
c - Throttle Shaft Spring

Cleaning and Inspection

1. Carefully inspect carburetor body and fuel bowl for cracks, stripped threads, plugged or restricted passages and passage plugs that show signs of leakage.
2. Thoroughly clean all carburetor parts with a mild cleaning solution (that will not damage rubber or plastic) to remove dirt, and varnish that may have accumulated.
3. After washing parts, blow parts dry with compressed air. Be sure to blow air thru all passages, orifices and nozzles.
4. Check float hinge in the float pin area for wear and check float for leaks. Replace parts as necessary.
5. Examine inlet needle for wear. If worn, replace with new inlet needle.

Carburetor Reassembly

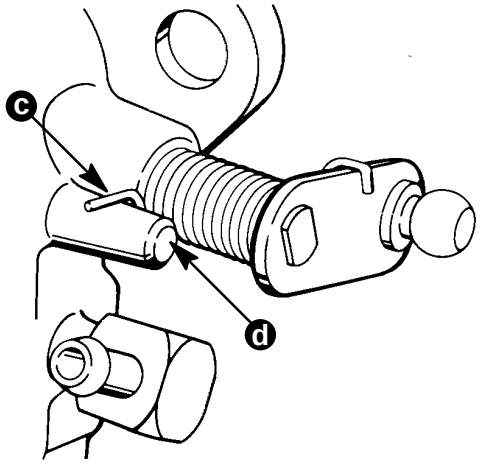
- If removed, install throttle shaft, throttle shutter plate, 2 screws (use Loctite Grade 'A'), and throttle shaft spring as shown. Install retaining clip on other end of shaft.



51117

a - Throttle Shaft
b - Screws (2) (Torque 6 lb. in. (0.7 N·m)
c - Throttle Shaft Spring

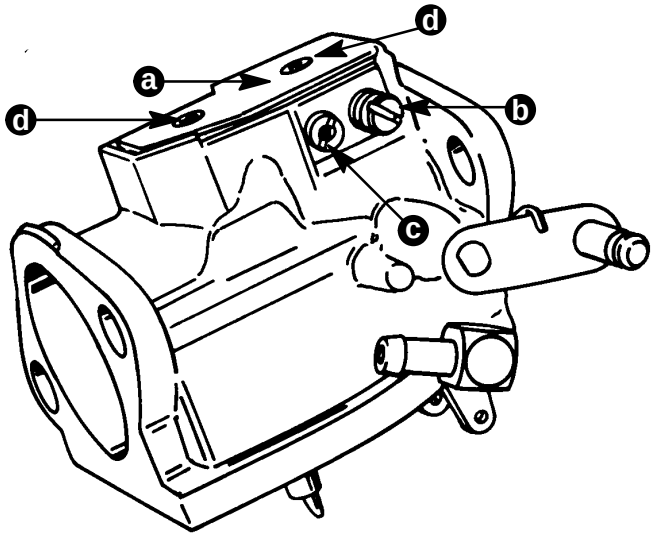
- Spring tension on stud.



51259

c - Spring
d - Stud

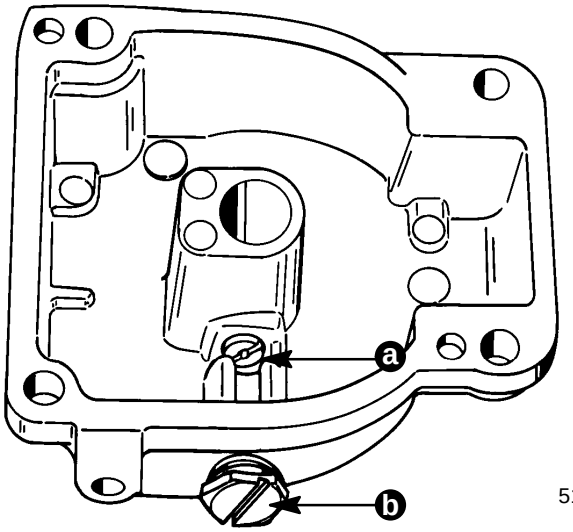
- Install mixing chamber cover and gasket as shown.
- Install idle mixture screw.
- Install bowl vent jet



51116

a - Mixing Chamber Cover and Gasket
b - Idle Mixture Screw
c - Bowl Vent Jet
d - Screw (2) Torque 18 lb. in. (2.1 N·m)

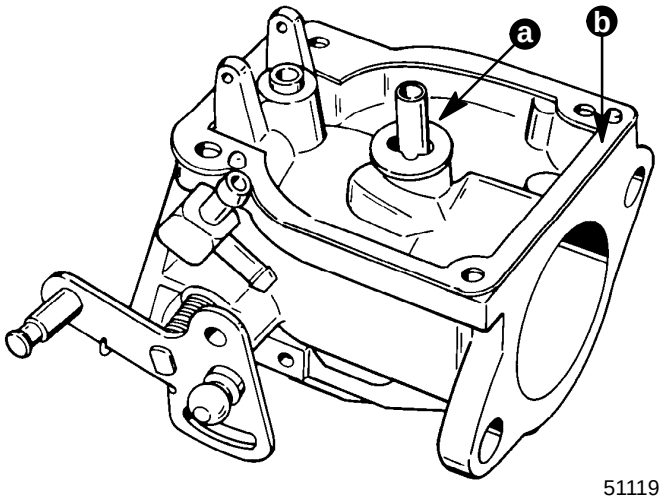
- Install main jet.
- Install main jet plug and gasket.



51116

a - Main Jet [Torque 14 lb. in (1.6 N·m)]
b - Main Jet Plug and Gasket [Torque 22 lb. in. (2.5 N·m)]

- Install stem gasket.
- Install fuel bowl gasket.

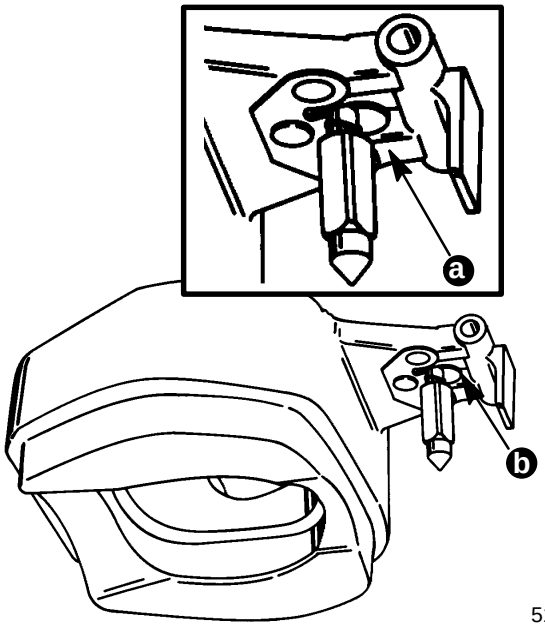


51119

a - Stem Gasket
b - Fuel Bowl Gasket

NOTE: *If Spring Clip on Inlet Needle was removed, or if needle was replaced, be sure spring clip is reattached.*

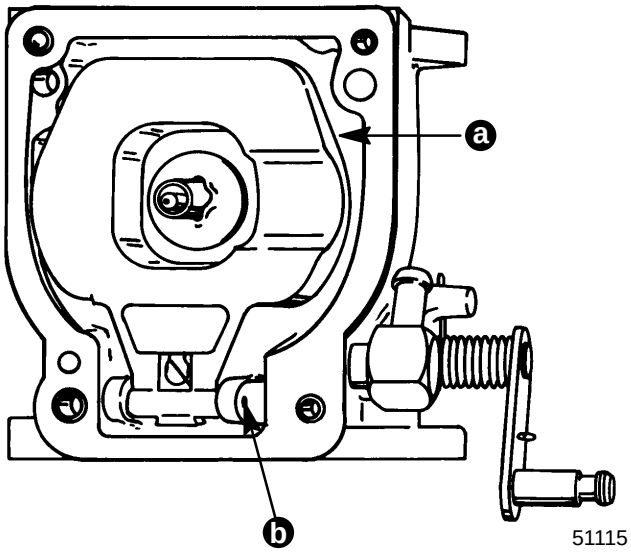
- Attach Spring Clip on Inlet Needle to metal float tab and place needle into its seat.



51115

a - Spring Clip
b - Float Tab

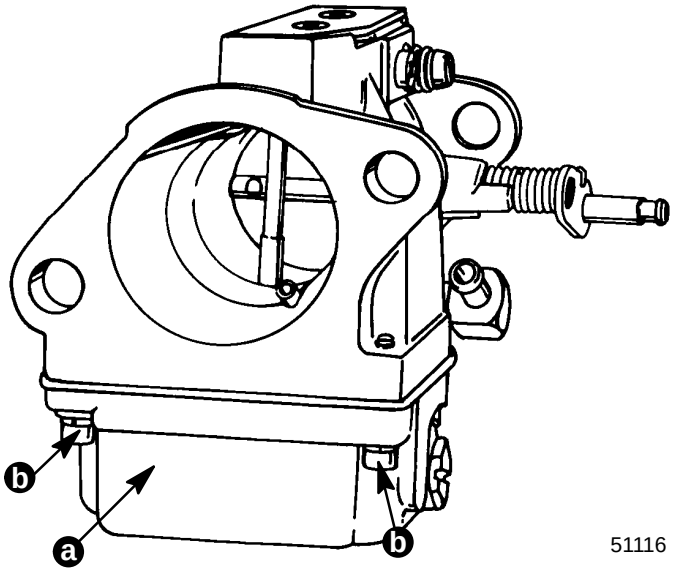
- Install float into carburetor with float pin.
- Adjust float following “Carburetor Float Adjustment,” Page 3A-13.



51115

a - Float
b - Float Pin

• Install float bowl.

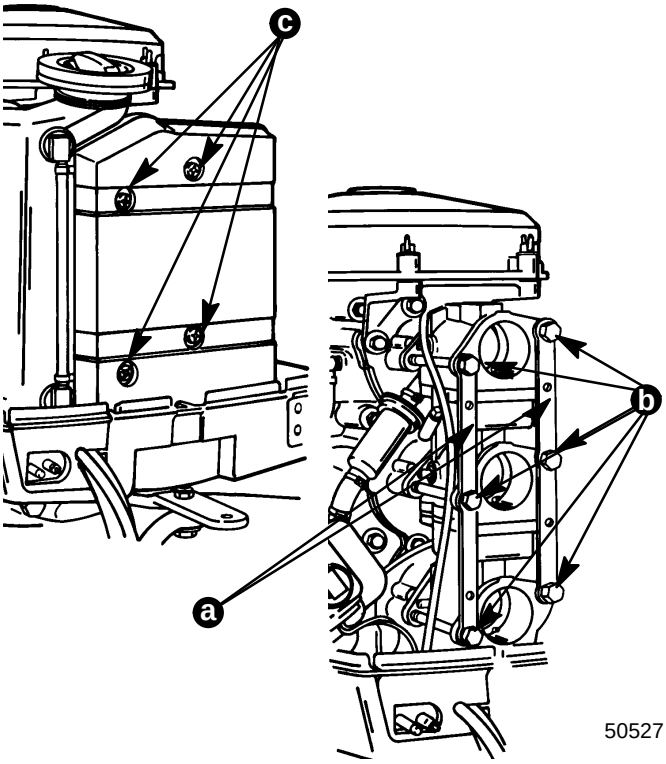


51116

a - Fuel Bowl
b - Screw (4) Torque 18 lb in. (2.1 N·m)

Carburetor Installation

- Install carburetors, attenuator plate, connect linkages, and fuel and primer lines.
- Install sound attenuator.



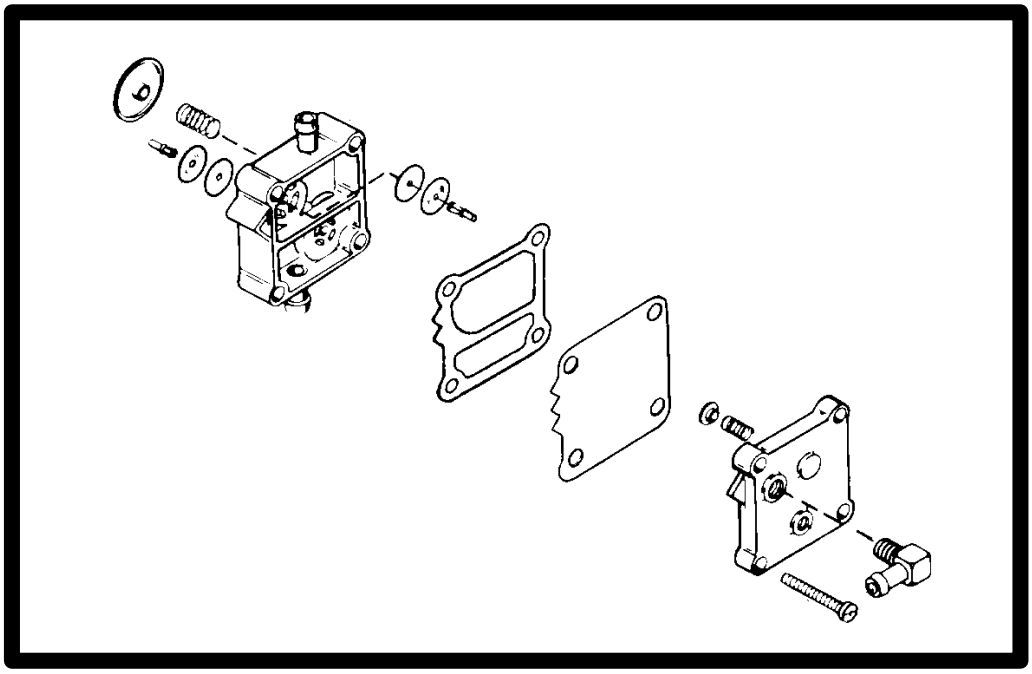
50527

a - Attenuator Brackets (2)
b - Carburetor Screw (6) Torque 100 lb. in. (11.5 N·m)
c - Attenuator Screw (4)

FUEL SYSTEMS

3

B



FUEL PUMP

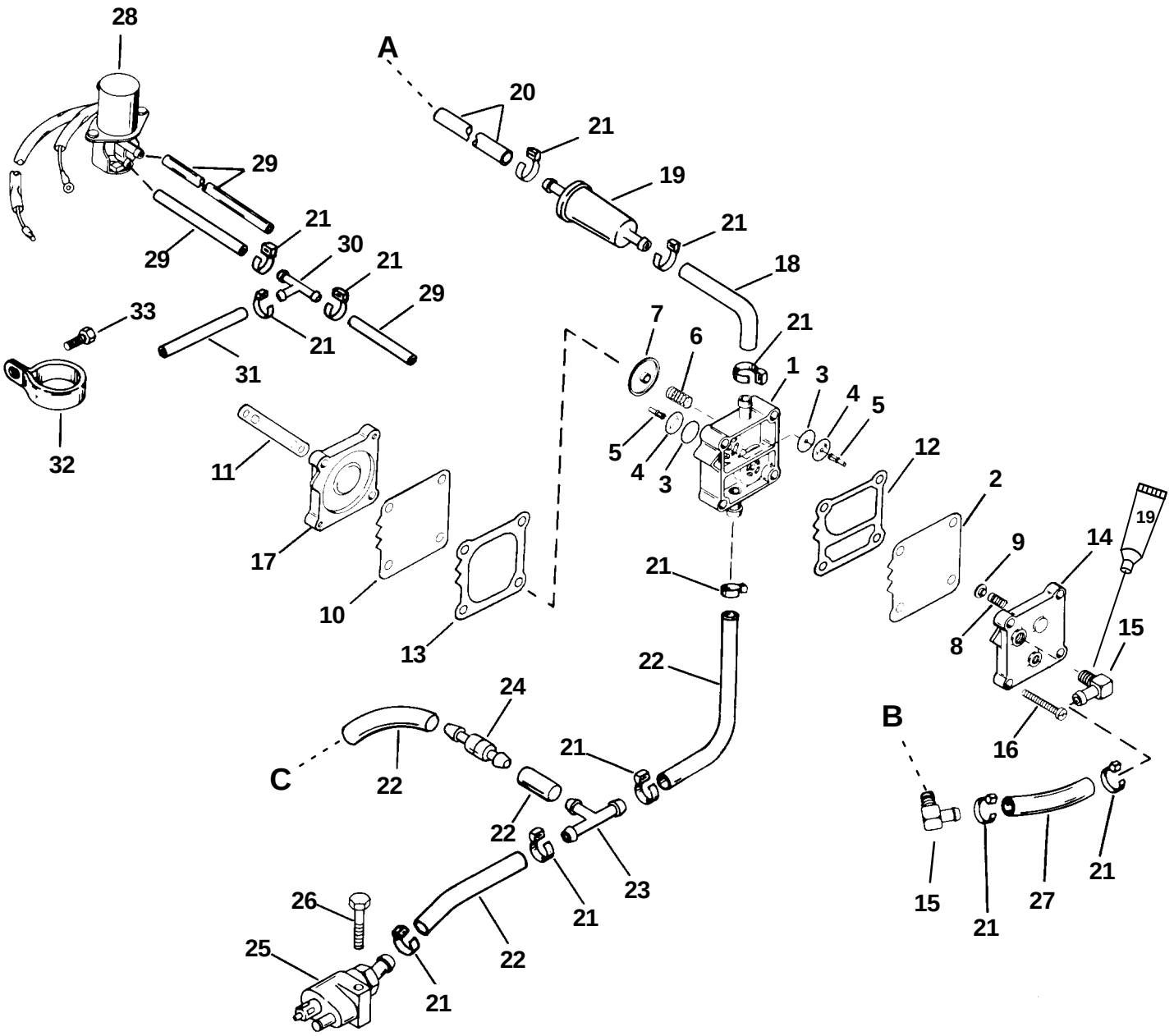
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Specifications

Fuel Pump Pressure (@ W.O.T.)	4-7 PSI (28-43 kPa)

Fuel Pump (50/60)



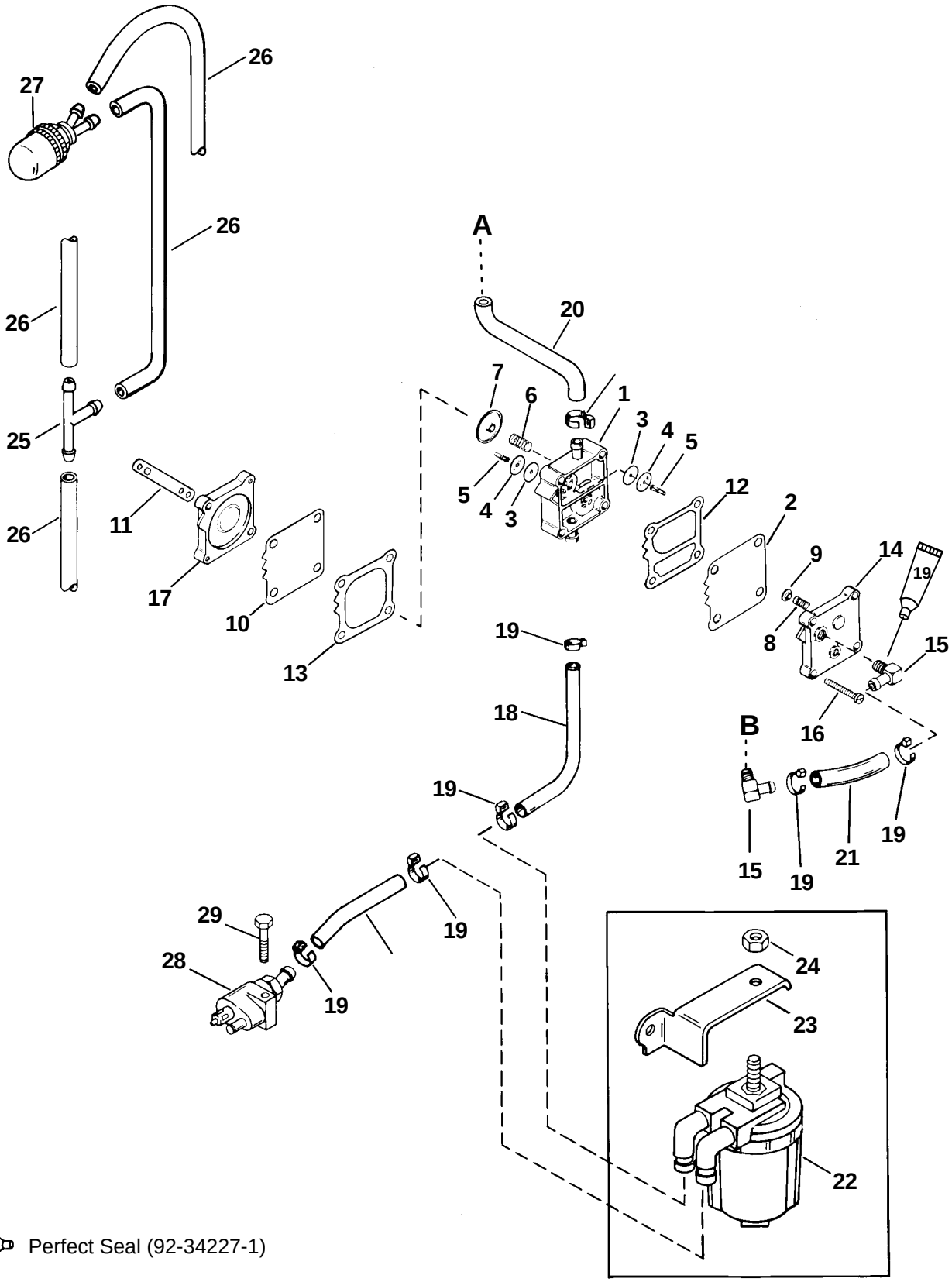
19 Perfect Seal (92-34227-1)

A – To Carburetor
B – To Crankcase
C – To Oil Pump

Fuel Pump (50/60)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	FUEL PUMP ASSEMBLY			
2	1	DIAPHRAGM KIT			
3	2	RUBBER CHECK VALVE			
4	2	CHECK VALVE			
5	2	RETAINER			
6	1	SPRING			
7	1	CAP			
8	1	SPRING			
9	1	CAP			
10	1	DIAPHRAGM			
11	1	GASKET			
12	1	GASKET–boost			
13	1	GASKET–pulse			
14	1	PLATE			
15	2	FITTING			
16	2	SCREW–fuel pump	55		6.0
16	2	SCREW–fuel pump to crankcase	55		6.0
17	1	BASE			
18	1	HOSE			
19	1	FUEL FILTER			
20	1	FUEL LINE			
21	AR	STA-STRAP			
22	3	HOSE (1-1/4″)(1-1/4″)(14-1/4″)			
23	1	TEE			
24	1	CHECK VALVE			
25	1	FUEL CONNECTOR			
26	1	SCREW	80		9.0
27	1	HOSE (4-1/4″)			
28	1	SOLENOID VALVE			
29	3	HOSE (1-3/4″)(3-1/4″)(11-1/2″)			
30	1	TEE FITTING			
31	1	HOSE (16″)			
32	1	CLAMP			
33	1	SCREW	100		135.5

Fuel Pump (55/60 Seapro/Marathon)



19 Perfect Seal (92-34227-1)

A – To Carburetor
B – To Crankcase

Fuel Pump (55/60 Seapro/Marathon)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	FUEL PUMP ASSEMBLY			
2	1	DIAPHRAGM KIT			
3	2	RUBBER CHECK VALVE			
4	2	CHECK VALVE			
5	2	RETAINER			
6	1	SPRING			
7	1	CAP			
8	1	SPRING			
9	1	CAP			
10	1	DIAPHRAGM			
11	1	GASKET			
12	1	GASKET–boost			
13	1	GASKET–pulse			
14	1	PLATE			
15	2	FITTING			
16	2	SCREW–fuel pump	55		6.0
16	2	SCREW–fuel pump to crankcase	55		6.0
17	1	BASE			
18	2	HOSE (10″)(14-1/4″)			
19	AR	STA-STRAP			
20	1	HOSE			
21	1	HOSE (4-1/4″)			
22	1	FUEL FILTER			
23	1	BRACKET			
24	1	NUT	Drive Tight		
25	1	TEE FITTING			
26	4	HOSE (1-1/2″)(5-1/2″)(9-1/2″)(9-1/2″)			
27	1	PRIMER BULB			
28	1	FUEL CONNECTOR			
29	1	SCREW	80		9.0

⚠ WARNING

FIRE AND EXPLOSION HAZARD. Observe fire prevention rules, particularly NO SMOKING. Before servicing any part of the fuel system, disconnect electrical system at the battery. Drain the fuel system completely. Use an approved container to collect and store fuel. Wipe up any spillage immediately. Materials used to contain spillage must be disposed of in an approved receptacle. Any fuel system service must be performed in a well ventilated area.

FUEL LEAKAGE FROM ANY PART OF THE FUEL SYSTEM CAN BE A FIRE AND EXPLOSION HAZARD WHICH CAN CAUSE SERIOUS BODILY INJURY OR DEATH. Careful periodic inspection of the entire fuel system is mandatory, particularly after engine storage. All fuel components, including fuel tanks, whether plastic, metal, or fiberglass, fuel lines, primer bulbs, fittings, swelling, and must be inspected for corrosion. Any sign of leakage or deterioration necessitates replacement before further engine operation.

Fuel Pumps

General Information

FUEL PUMP DESCRIPTION/OPERATION

The fuel pump is a crankcase-pressure-operated, diaphragm-type pump. Crankcase pulsating pressure is transferred by way of a passage (hole) from the crankcase to the fuel pump.

When the piston travels upward, a vacuum is created in the crankcase. This vacuum pulls in the fuel pump diaphragm, the inlet check valve (in fuel pump) is opened and, and fuel is drawn into fuel pump.

Downward motion of the piston forces out the fuel pump diaphragm, closes the inlet check valve (to keep fuel from returning to fuel tank) and opens the outlet check valve, forcing fuel to the carburetors.

CHECKING FOR RESTRICTED FUEL FLOW CAUSED BY ANTI-SIPHON VALVES

While anti-siphon valves are helpful from a safety standpoint, they clog, they may be too small, or they may have too heavy a spring. The pressure drop occures these valves can create operational problems and/or powerhead damage by restricting flow of fuel. Some symptoms of restricted (lean) fuel flow, are:

1 - Loss of fuel pump pressure
2 - Loss of power
3 - High speed surging
4 - Preignition/detonation (piston dome erosion)
5 - Outboard hesitates upon acceleration
6 - Outboard runs rough
7 - Outboard quits and cannot be restarted
8 - Outboard will not start
9 - Vapor lock

Any type of anti-siphon device must be located between the outboard fuel inlet and fuel tank outlet. A method of checking [if such a device (or bad fuel) is a problem source] is to operate the outboard with a separate fuel supply which is known to be good.

If it is found that the anti-siphon valve is the cause of the problem, either 1) replace the anti-siphon valve, or 2) replace it with a solenoid-operated fuel shutoff valve.

Testing

Install clear fuel hose(s) between fuel pump and carburetor(s). Run engine, and inspect hose(s) for air bubbles. If air bubbles are found, see “Air Bubbles in Fuel Line” . If air bubbles are NOT found, see “Lack of Fuel Pump Pressure”.

Troubleshooting Fuel Pump

PROBLEM: AIR BUBBLES IN FUEL LINE	
Possible Cause	**Corrective Action**
Low fuel in fuel tank.	Fill tank
Loose fuel line connection	Check and tighten connections.
Fuel pump fitting loose.	Tighten fitting.
A hole or cut in fuel line.	Check condition of fuel lines and replace any found bad.
Fuel pump anchor screw(s) loose.	Tighten all screws
Fuel pump gasket(s) worn out.	Rebuild fuel pump.

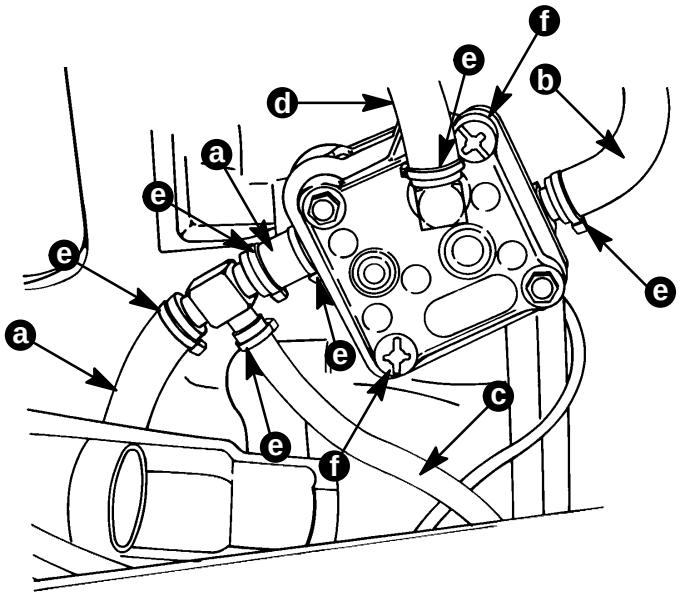
PROBLEM: LACK of FUEL PUMP PRESSURE

Possible Cause	Corrective Action
An anti-siphon valve	Read “Checking for Restricted Fuel Flow Caused by Anti-Siphon Valves” preceding.
Air in fuel line	“Air Bubbles in Fuel Line,” preceding.
A dirty or clogged fuel filter	Clean or replace filter.
The fuel pickup in fuel tank clogged or dirty.	Clean or replace pickup.
Worn out fuel pump diaphragm.	Rebuild pump.
Defective (hole or crack) check valve(s) in fuel pump (unlikely).	Rebuild pump.
Broken check valve retainer.	Rebuild pump.
Pulse hole plugged.	Remove pump and clean out hole.
Hole in pulse hose.	Replace pulse hose
Loose pulse hose.	Tighten connection.
Boost diaphragm gasket distorted or out of place.	Check seal between mating surfaces where “rib” divides pulse chamber and gasket must align with rib; check for distorted gasket. Align or replace gasket if necessary.

IMPORTANT: Align diaphragm aligning tabs with fuel pump aligning tabs during reassembly.

Fuel Pump Removal

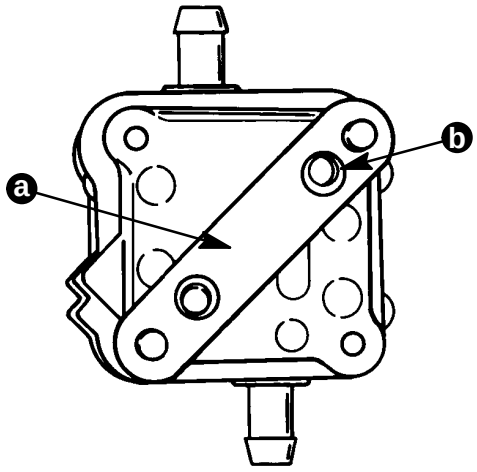
1. Remove oil tank from outboard. Refer to Section 8A “Oil Injection System.”
2. Remove fuel “inlet” hose, (a) “outlet” hose, (b) and pulse hose (d).
3. Remove two bolts (f) securing fuel pump to power-head.



51267

a - Inlet Fuel Hose
b - Outlet Fuel Hose
c - Oil Injection hose - From Oil Tank
d - Pulse Hose - From Crankcase
e - Sta-Strap (6)
f - Bolts (2)

4. Remove gasket from backside and replace gasket as necessary -- check gasket in port area.

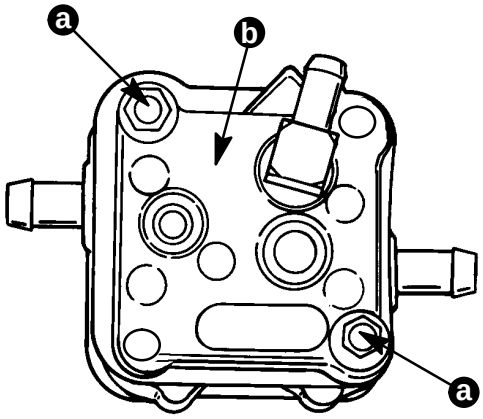


51267

a - Gasket
b - Port Area

Fuel Pump Disassembly

1. Remove bolts (a) and chamber plate (b).



51267

2. Disassemble fuel pump as shown in “Fuel Pump Exploded View.”

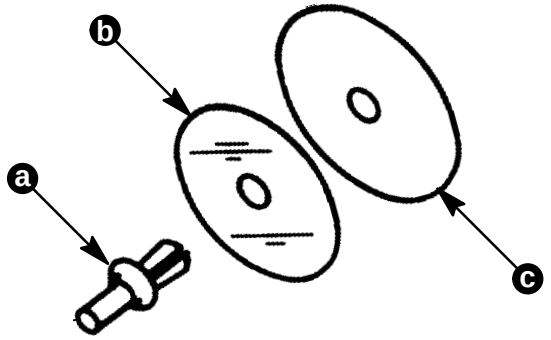
Cleaning and Inspection

1. Clean fuel pump housing, chamber plate and pump base, then dry with compressed air.
2. Look at spring for signs of bad coils or other damage.
3. Check pump body, chamber plate and pump base, for cracks or rough gasket surfaces.
4. Check hoses for looseness or signs of leakage.
5. Look at check valve discs for cracks, tears, or other damage.
6. Repair of fuel pump is limited to the replacement of those bad parts found during inspection.

Fuel Pump Reassembly

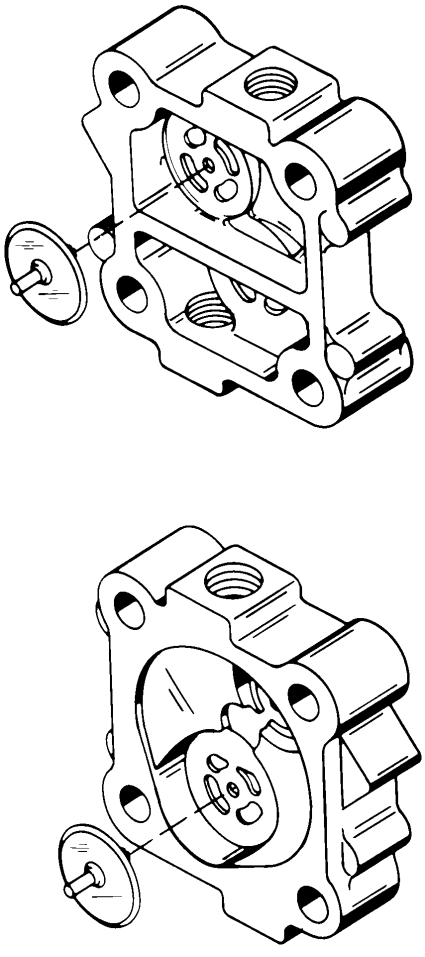
Check Valve Assembly

1. Insert retainer (a) thru plastic disc (b) and rubber check valve (c).



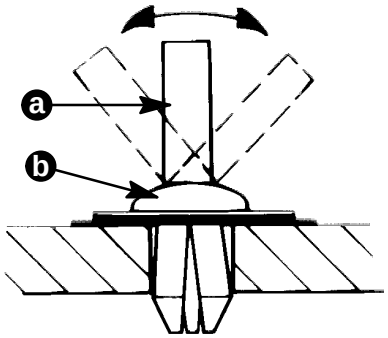
23601

2. Install check valves and retainers into fuel pump body.

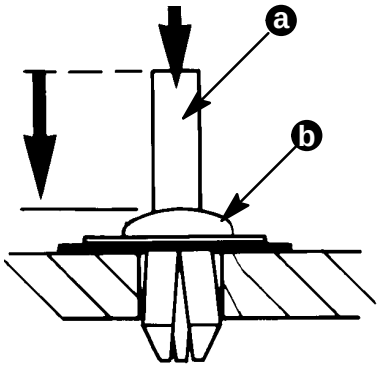


23601

3. With retainer installed in pump body, break retainer rod (a) from retainer (b) by bending sideways.
4. Reinstall rod (a) into retainer cap (b) and, use a small hammer or hammer and punch to tap rod down into retainer until flush with top of retainer.



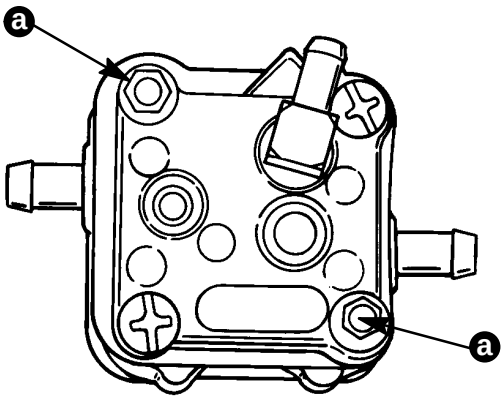
23601



23610

Fuel Pump Assembly

1. Assemble remaining components as shown in “Fuel Pump Exploded View”.
2. Install bolts (a) and torque to 40 lb. in. (4.5 N·m).



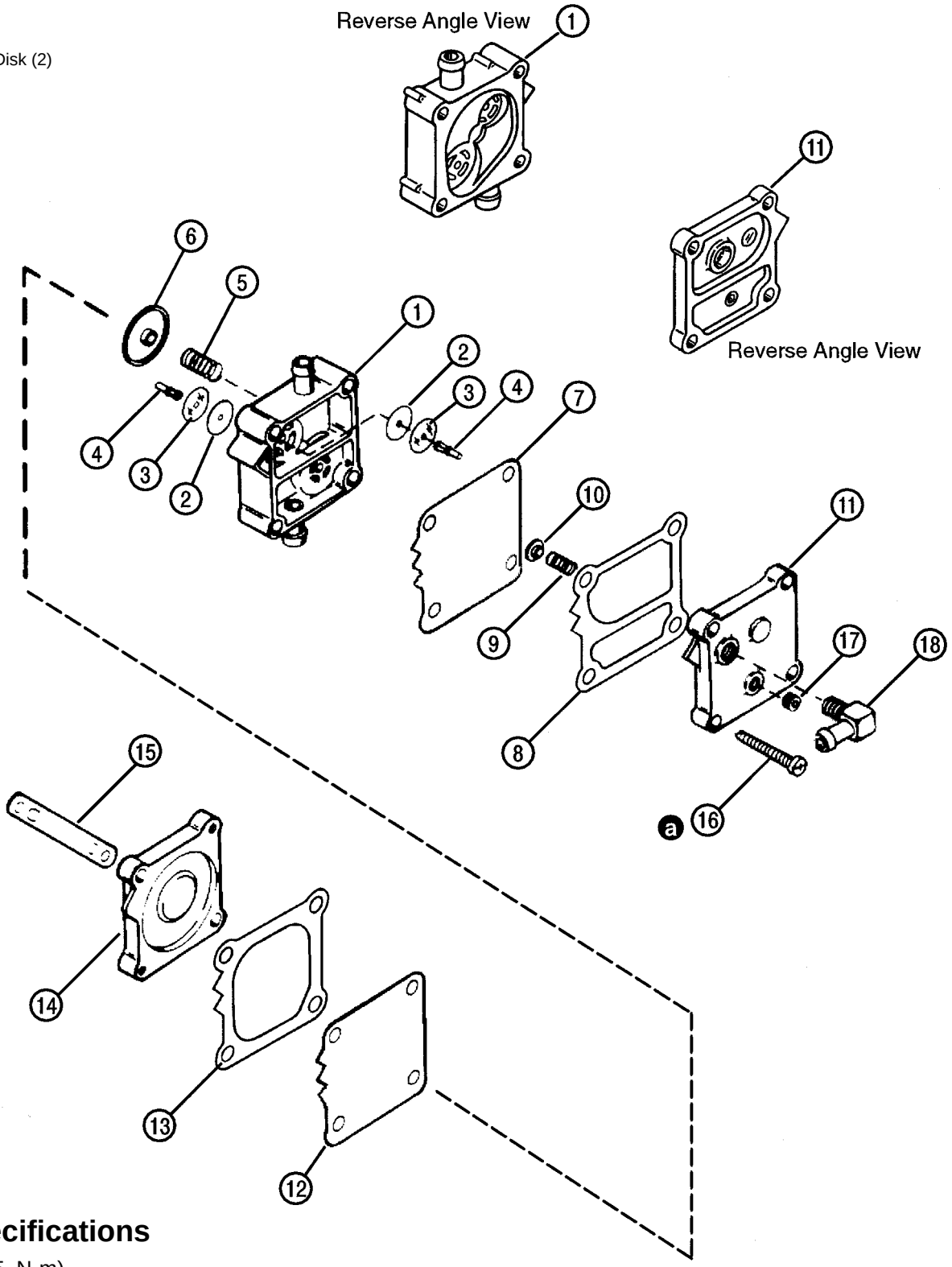
51267

Fuel Pump Exploded View

IMPORTANT: Align all gasket and diaphragm aligning tabs with fuel pump aligning tabs during reassembly.

NOTE: *In fuel pump reassembly, remember that respective diaphragms go against the mating surfaces of the fuel pump body, and respective gaskets are between the diaphragms and end caps. Gaskets should always be replaced on fuel pump during reassembly.*

1- Fuel Pump Body
2- Rubber Disc (2)
3- Plastic Check Valve Disk (2)
4- Retainer (2)
5- Spring
6- Cap
7- Diaphragm
8- Boost Gasket
9- Spring
10- Cap
11- Chamber Plate
12- Diaphragm
13- Pulse Gasket
14- Fuel Pump Base
15- Gasket
16- Bolt 40mm (2)
Bolt 50mm (2)
17- Pipe Plug
18- Fitting 90°



50569

Torque Specifications

ⓐ 40 lb. in. (4.5 N·m)

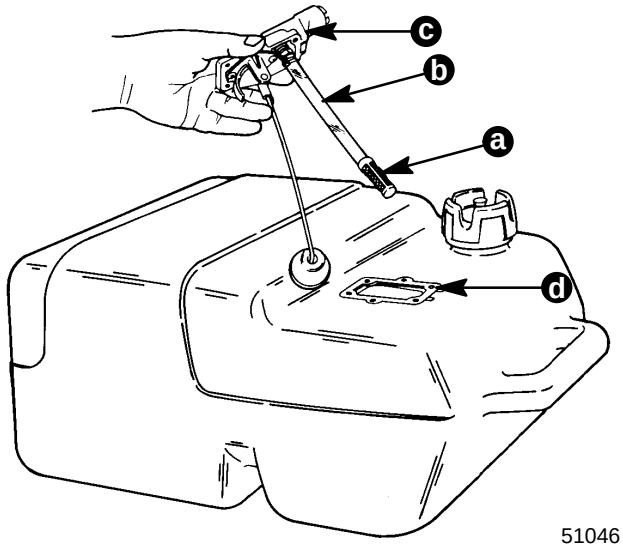
NOTE: *Gaskets, items 8 and 13 were not used on early production units, however they should be installed when rebuilding a fuel pump.*

Fuel Tank

Maintenance

The inside of the fuel tank should be cleaned once each season. Dirt or water may have entered the fuel tank during refilling. Clean the tank by flushing with clean, lead-free gasoline or kerosene.

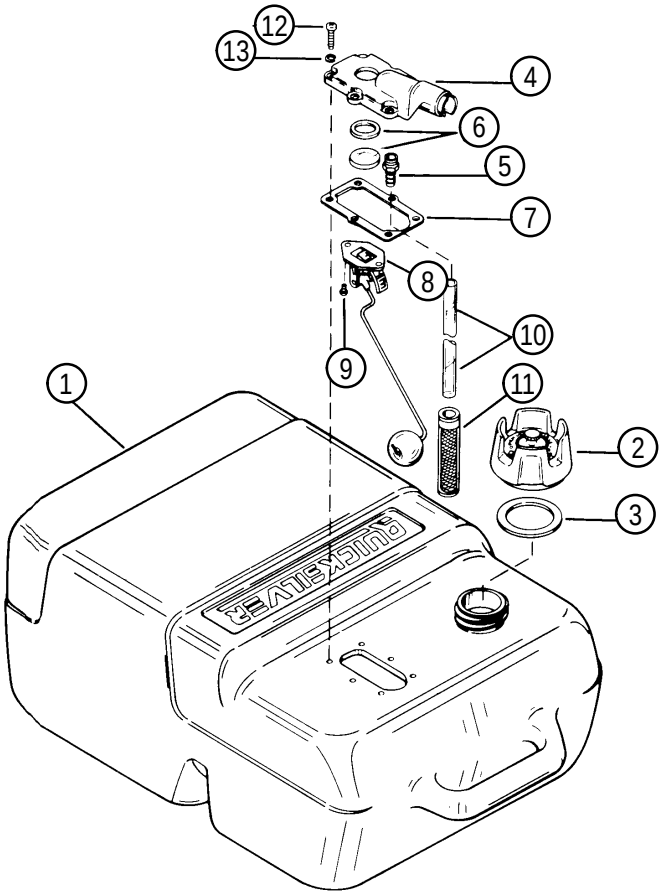
If a fuel restriction problem is encountered, the fuel filter on end of outlet tube may be obstructed. Remove cover and inspect filter for varnish, dirt or deposits. Clean filter by rinsing in clean, lead-free gasoline or kerosene.



51046

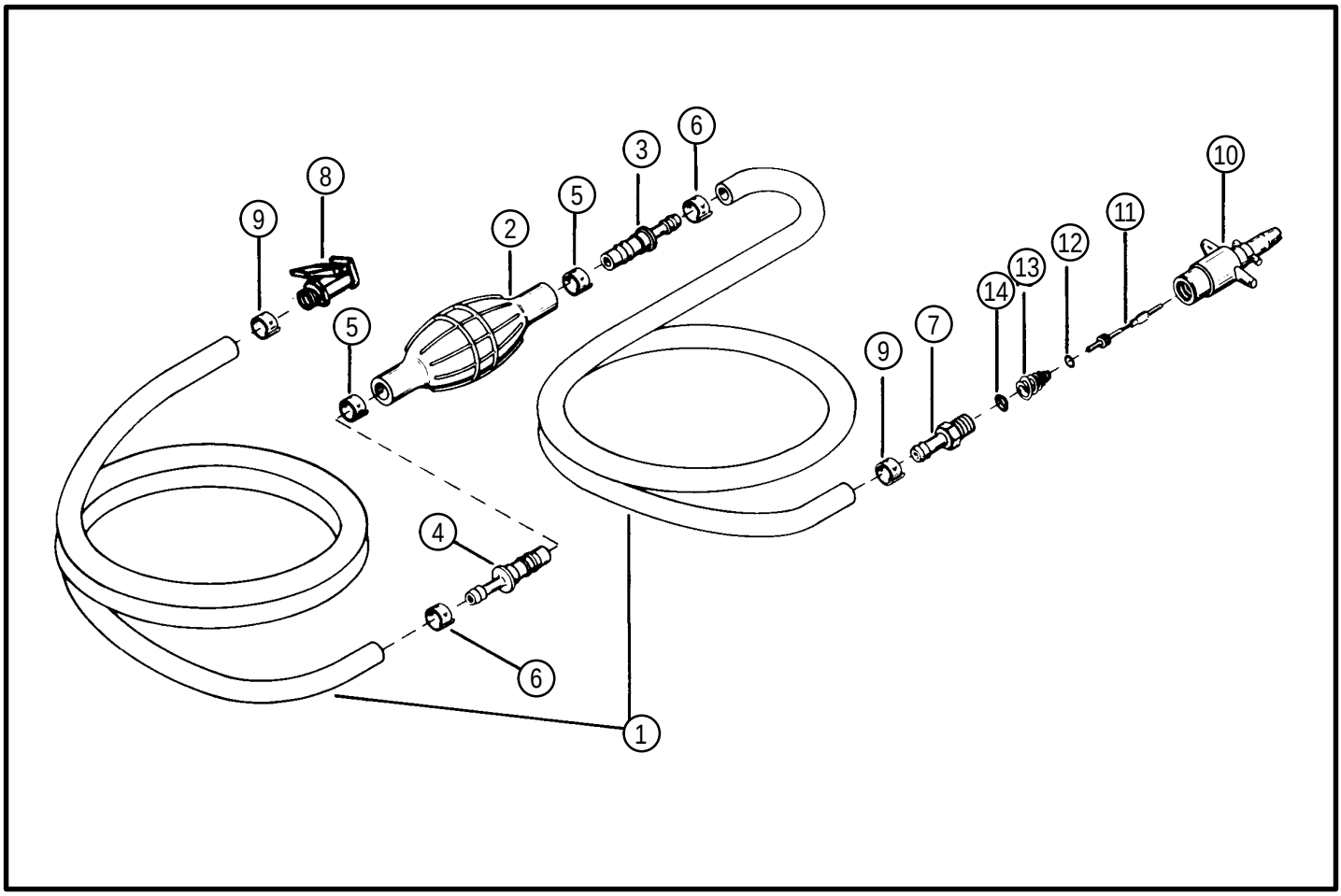
a - Fuel Tank Filter
b - Pick-Up Tube
c - Cover
d - Gasket

Fuel Tank Components



REF. NO.	DESCRIPTION	QUAN.
1	FUEL TANK ASSEMBLY (PLASTIC-6.6 GAL.)	1
2	FILLER CAP	1
3	GASKET, filler cap	1
4	PICK-UP BODY ASSEMBLY	1
5	ADAPTOR	1
6	WINDOW ASSEMBLY	1
7	GASKET, pick-up body	1
8	FUEL GAUGE ASSEMBLY	1
9	SCREW, fuel gauge	2
10	HOSE	1
11	FILTER	1
12	SCREW, pick-up body	6
13	WASHER, pick-up body screw	6

Fuel Line and Primer Bulb Assembly



REF. NO.	DESCRIPTION
1	FUEL LINE ASSEMBLY
2	PRIMER BULB ASSEMBLY
3	CHECK VALVE, inlet
4	FITTING, outlet
5	CLAMP, primer bulb to check valve (LARGE)
6	CLAMP, fuel line to check valve (SMALL)
7	CONNECTOR, fuel tank (OUTLET)
8	CONNECTOR, engine (INLET)
9	CLAMP, fuel line to connector
10	BAYONET BODY ASS'Y (FUEL TANK END)
11	STEM, bayonet body
12	"O" RING, bayonet body stem
13	SPRING, bayonet body stem
14	WASHER, CUPPED - body spring

Maintenance

Periodically check fuel line and primer bulb for cracks, breaks, restrictions or chafing. Check all fuel line connections for tightness. All fuel line connections must be clamped securely.

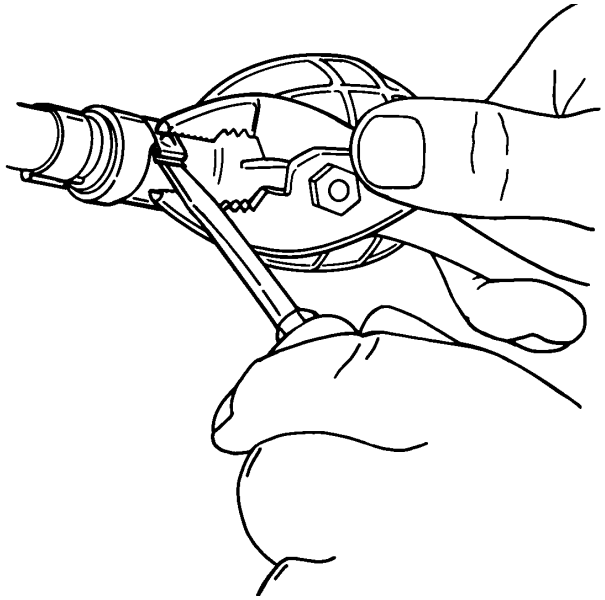
Primer bulb assembly has 2 check valves: Fuel inlet (toward tank) and a fuel outlet (toward engine).

The fuel inlet valve allows fuel to fill primer bulb but closes to prevent fuel from returning to tank when bulb is squeezed. The fuel outlet valve opens when primer bulb is squeezed to allow fuel flow to carburetor, but closes as bulb is released to prevent fuel from returning to primer bulb.

FUEL LINE CLAMP REMOVAL AND INSTALLATION

1. To remove fuel line clamps, grip clamp with pliers and bend over, lapping hook backward.

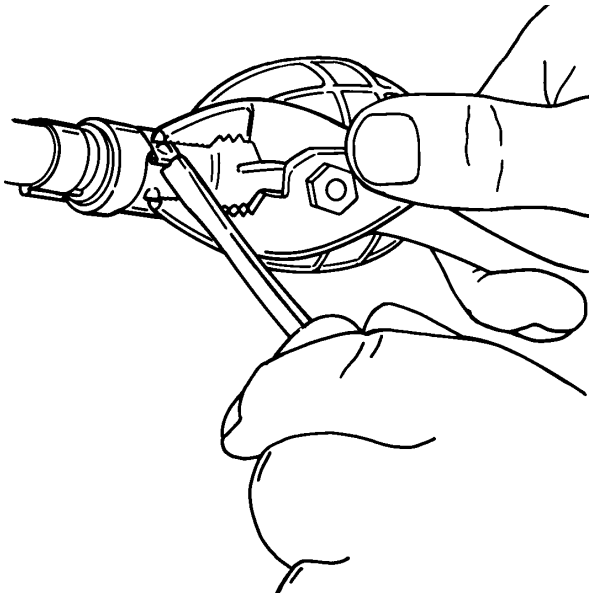
Removing Fuel Line Clamps



51115

2. To install fuel line clamps, grip hose clamp with pliers and push down on hook with screwdriver until hooks interlock.

Installing Fuel Line Clamps

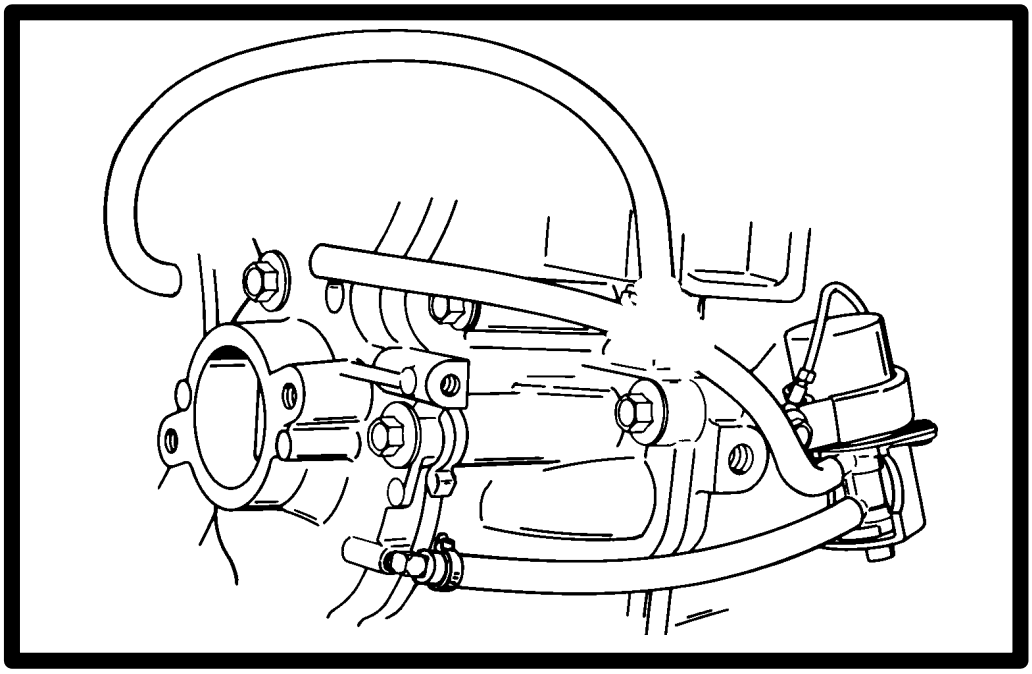


51115

FUEL SYSTEMS

3

C



ENRICHMENT

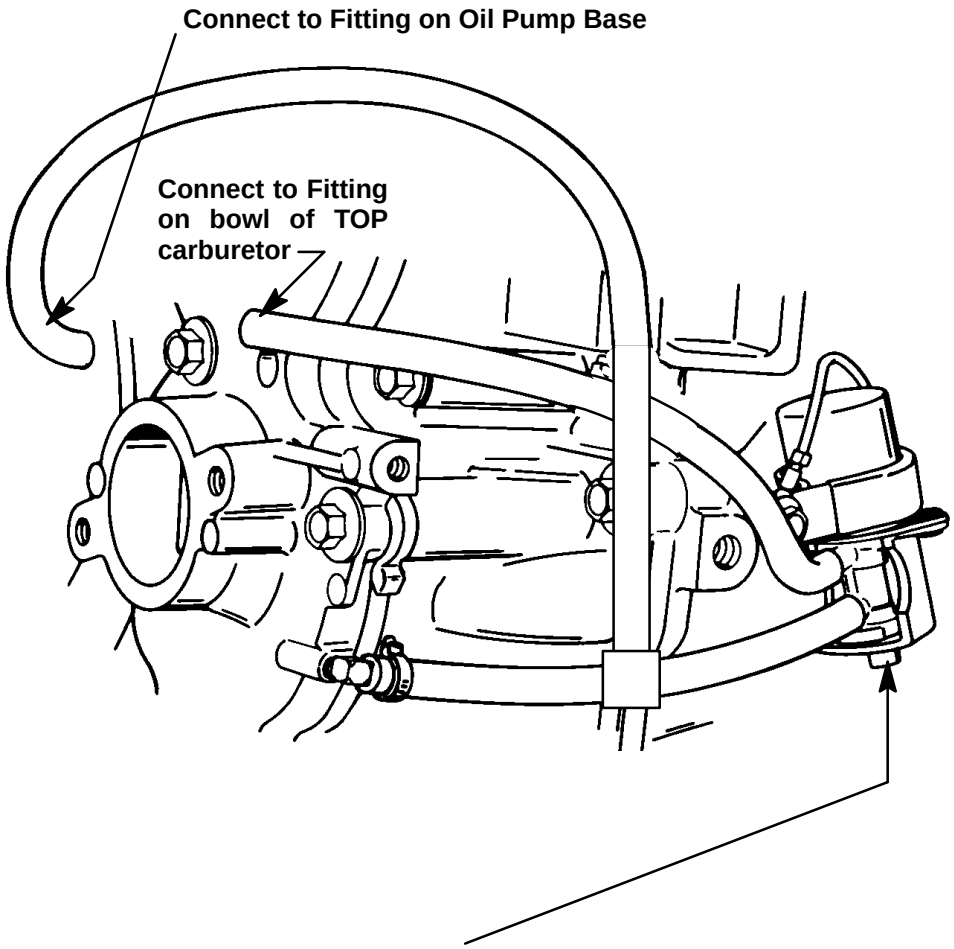
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Enrichener Valve Test	3C-2

Enrichener System

The enrichener system provides the engine with extra fuel charge for ease of starting cold engine. The system consists of an electrically operated enrichener valve which is connected by a hose to the intake manifold.

Fuel is gravity fed to the valve from the float bowl of the top carburetor via a hose. When the ignition key is turned to the “on” position and pushed in (and held in) current is sent to the valve causing it to open, which allows fuel to pass thru. The fuel passes thru a hose and is supplied to the engine via fitting located in the intake manifold of the middle carburetor. When the key (or choke button) is released, the valve will return to the closed position. The valve can be operated manually by pressing and holding button located at bottom of valve.


Connect to Fitting on Oil Pump Base
Connect to Fitting on bowl of TOP carburetor
Enrichener Valve Manual Operation Button

51223

IMPORTANT: Use of enrichener if engine is warm could result in engine flooding

ENRICHENER VALVE TEST

Push key (or choke button) in. Valve should click

No Click

Check for battery voltage to YELLOW/BLACK wire at terminal block on engine when key (or choke button) is pushed in.

Battery Voltage Indicated

Check for loose or corroded connection between YELLOW/BLACK wire and black wire (under same screw at terminal block).

Check that other BLACK wire at terminal block is properly grounded.

Repair connections(s) as necessary, then push key (or choke button) in. If enrichener valve DOES NOT click, replace valve.

No Voltage Indicated

Check for open in YELLOW/BLACK wire between key switch (or choke button) and terminal block.

Click

Squeeze primer bulb until bulb is firm. Remove lower hose from fitting on enrichener valve. Place a container under valve, then push key (or choke button). Check for fuel flow from fitting.

Fuel Flow from Fitting

Valve is O.K. Check hoses and fittings from valve to carburetors for leaks or obstructions.

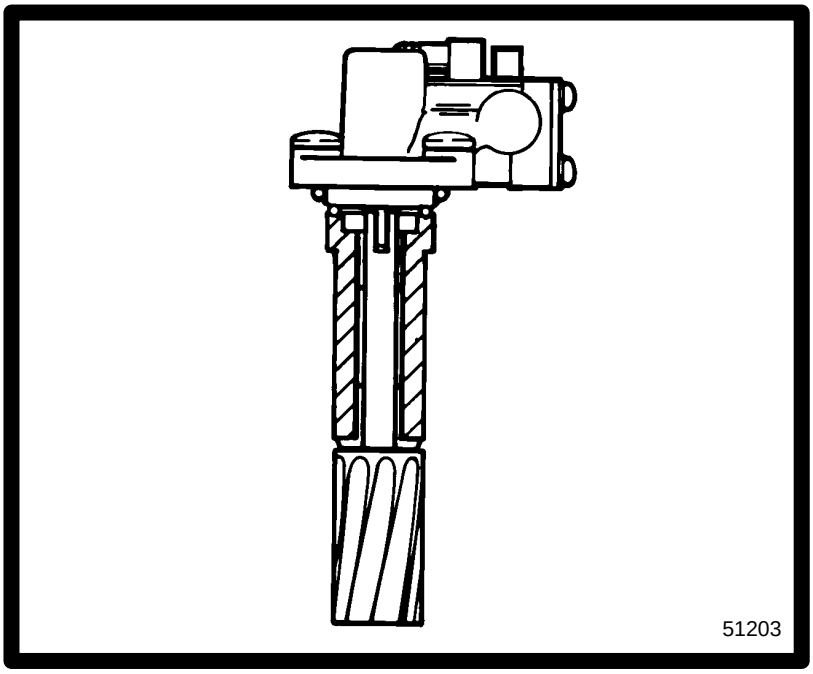
No Fuel Flow from Fitting

Remove upper hose from fitting on enrichener valve. If fuel flows from hose, replace valve. If not, check hose and carburetor fittings for leaks or obstructions.

FUEL SYSTEMS

3

D



OIL INJECTION

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Operation of the Injection System

The oil injection system delivers a oil mixture thru a constant ratio oil pump.

The engine mounted oil reservoir holds 3 qts. (2.8 Liters) which will provide 10.5 hours of running time at wide open throttle.

A low oil warning horn will be activated when 14.5 fl. oz. (435 ml) of oil remains in the reservoir. This will provide approximately 1.5 hours of wide open throttle running before oil is depleted.

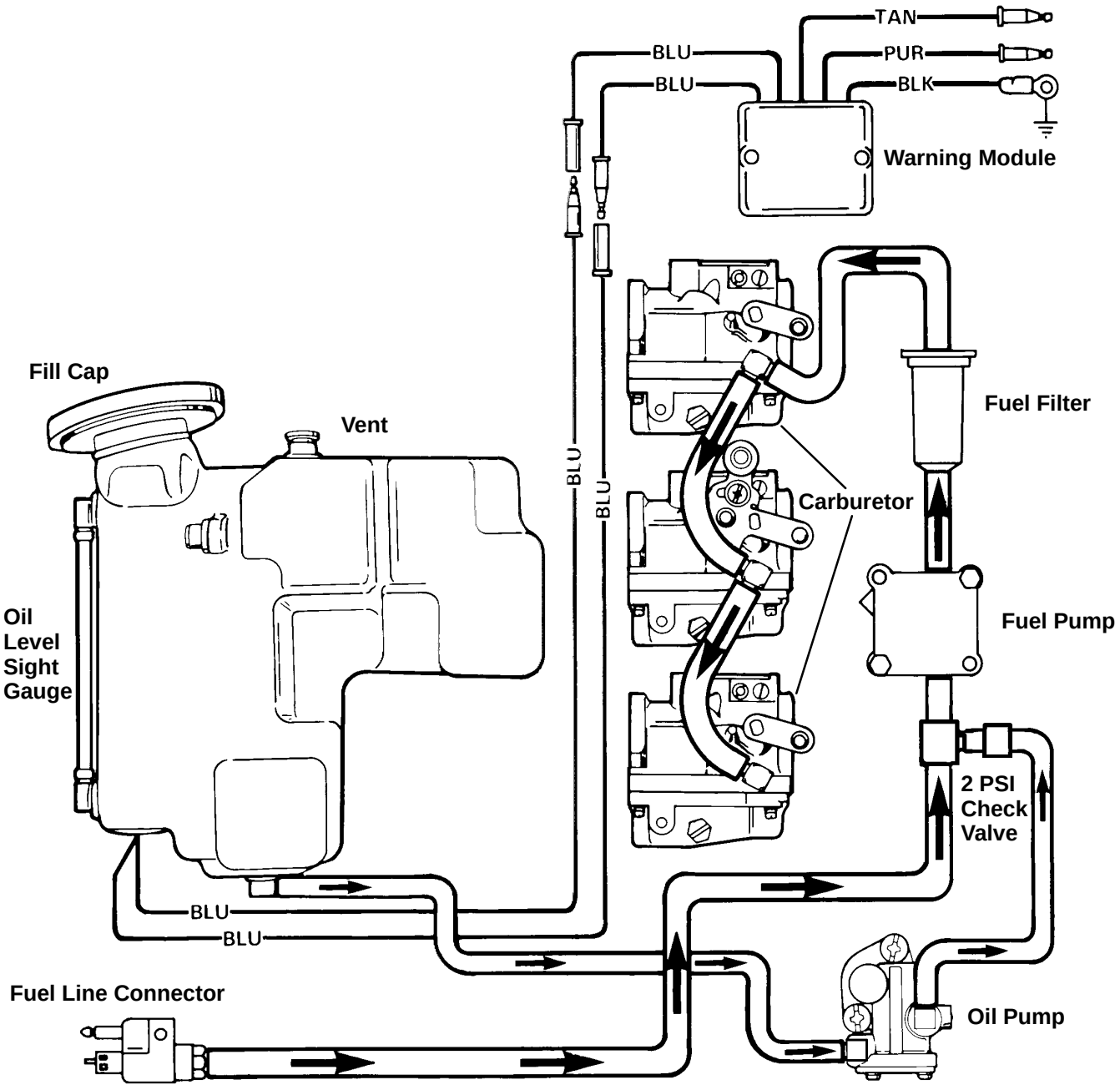
The crankshaft driven oil pump injects oil into the fuel before the fuel pump.

Oil Injection System

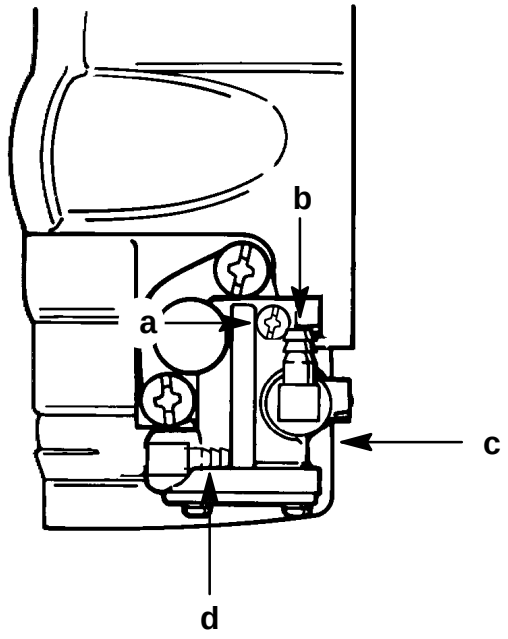
1. **Oil Reservoir**
   The oil reservoir gravity feeds oil to the oil pump. The reservoir contains a low oil sensor which activates a warning horn when 14.5 fl. oz. (435 ml) of oil remains in the reservoir.
2. **Oil Injection Pump**
   The crankshaft driven oil pump is a constant ratio oil pump which provides an oil fuel mixture.
3. **Check Valve Vent**
   Provides air to oil reservoir for proper venting and also prevents oil leaks when outboard is tilted forward.
4. **2 PSI Check Valve**
   This valve prevents gasoline from being forced into oil line.
5. **Low Oil Sensor**
   When oil level in reservoir drops to approximately 14.5 fl. oz. (435 ml), the sensor will signal warning module to activate warning horn.
6. **Warning Module**
   When ignition key is initially turned on, the warning module will briefly provide a self test of its engine overheat warning system - a brief continuous BEEP tone, followed by a self test of its low oil warning system - a brief intermittent BEEP-BEEP tone.

If the oil in the reservoir drops to less than 14.5 fl. oz. (435 ml), the low oil sensor in the reservoir will signal the warning module to activate the warning horn. If the powerhead temperature should exceed 300° F (65° C), the overheat temperature sensor in the water jacket cover will signal the warning module to activate the warning horn.

Oil Injection Flow System (Fixed Ratio Oil Pump)

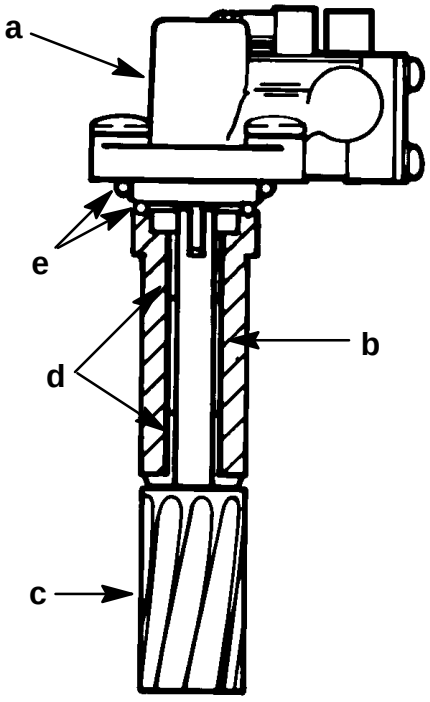


Pump Drive Assembly (Fixed Ratio Oil Pump)



51203

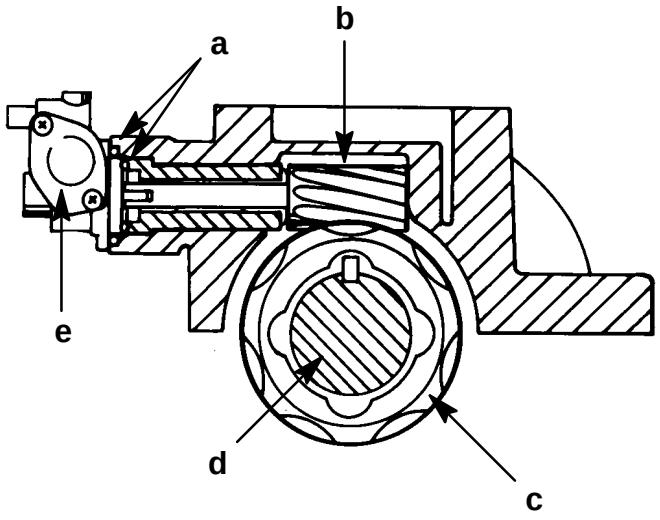
a - Bleed Screw
b - Oil Outlet
c - Oil Pump
d - Oil Inlet



51203

a - Oil Pump
b - Apply 2-4-C w/Teflon to Shaft
c - Driven Gear
d - Bushings
e - O-Rings

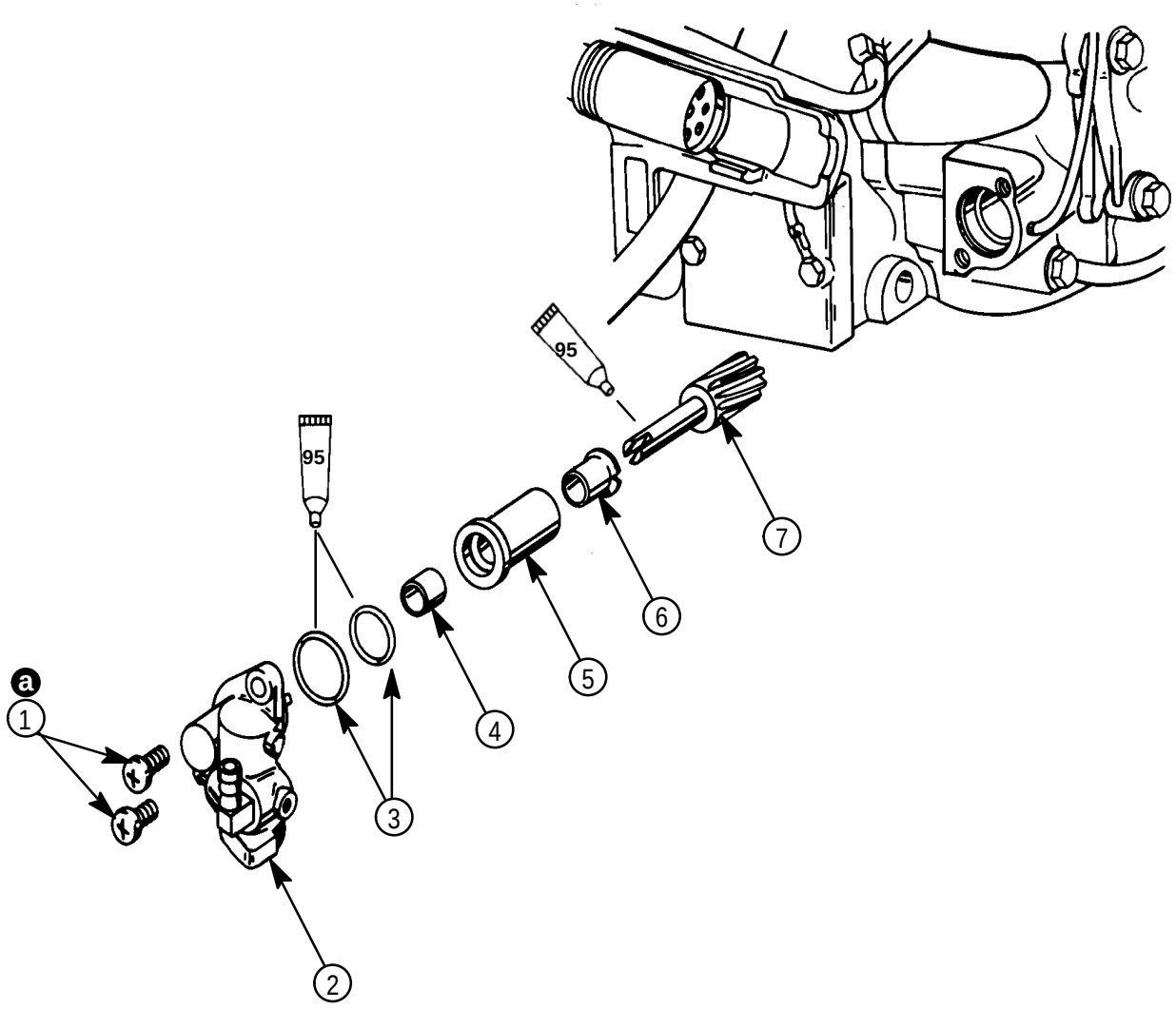
Pump Drive System (Fixed Ratio Oil Pump)



51203

a - O-Rings
b - Driven Gear
c - Drive Gear
d - Crankshaft
e - Oil Pump

Oil Pump to Powerhead Assembly (Fixed Ratio Oil Pump)



51203

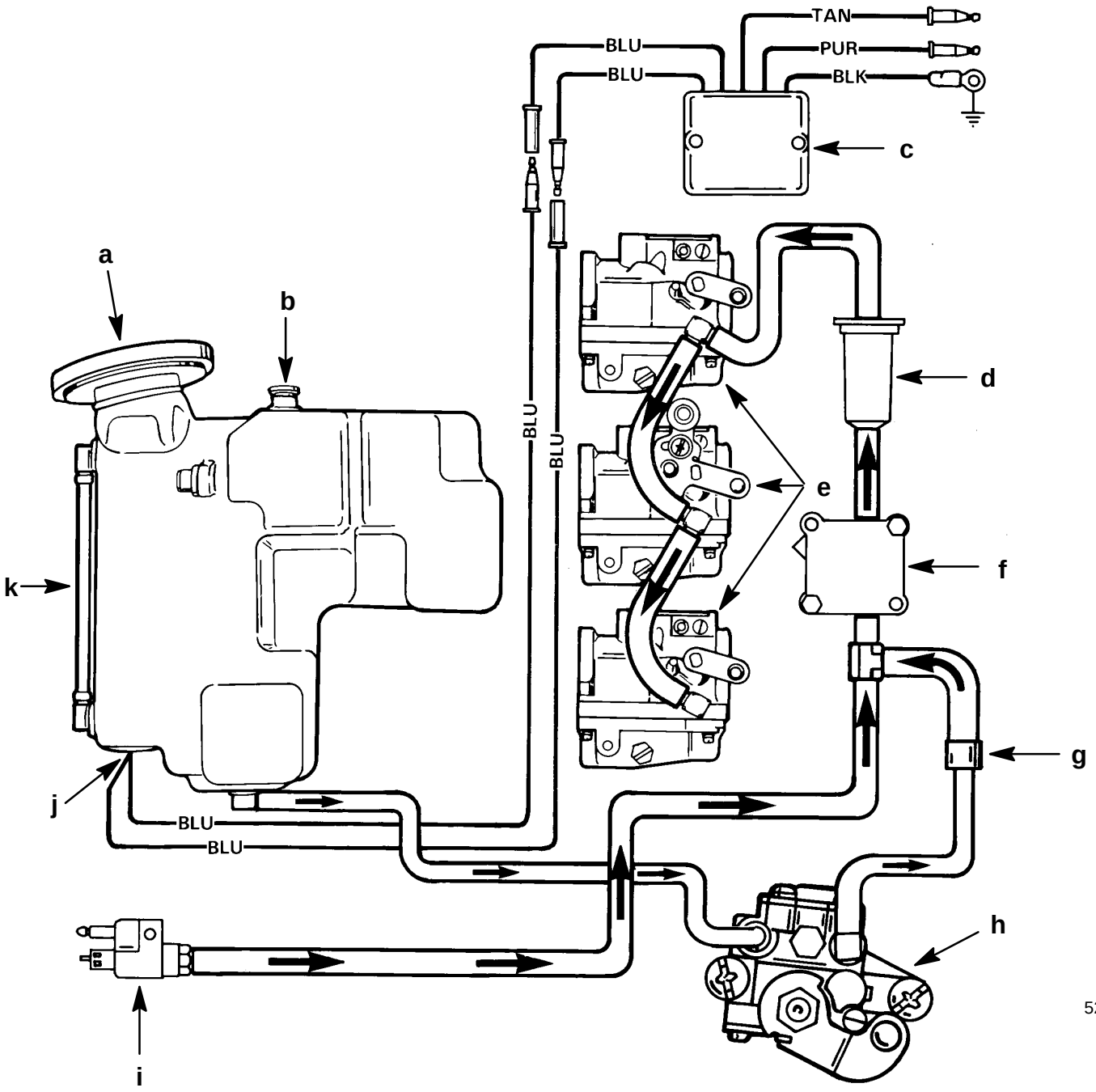
95 2-4-C With Teflon (92-825407A12)

TORQUE SPECIFICATIONS

a 60 lb. in. (7.0 N·m)

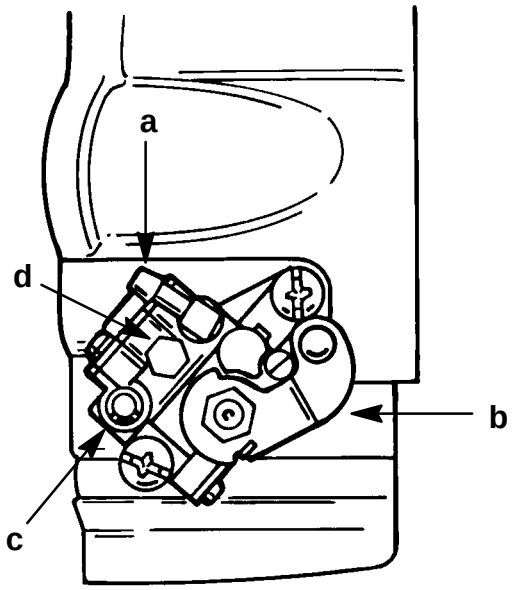
1 - Bolt
2 - Oil Pump
3 - O-Rings
4 - Bushing
5 - Bearing
6 - Bushing
7 - Driven Gear

Oil Injection Flow System (Variable Ratio Oil Pump)



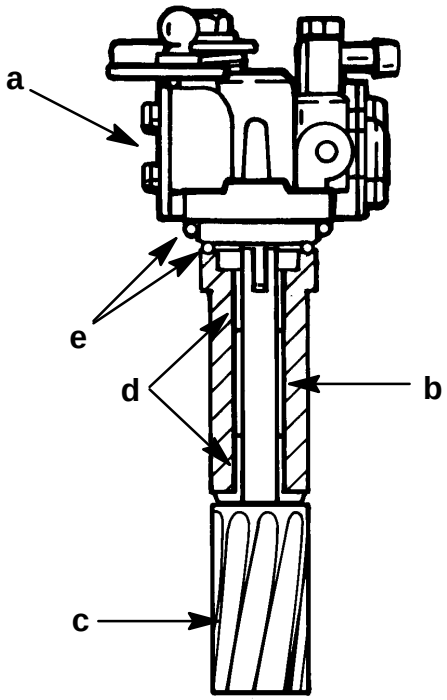
a - Fill Cap
b - Vent
c - Warning Module
d - Fuel Filter
e - Carburetors
f - Fuel Pump
g - 2 psi Check Valve
h - Oil Pump
i - Fuel Line Connector
j - Low Oil Sensor
k - Oil Level Sight Gauge

Pump Drive Assembly (Variable Ratio Oil Pump)



52046

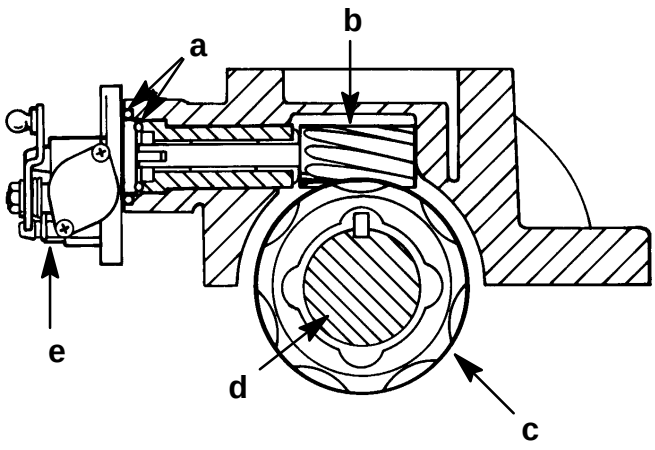
a - Oil Outlet
b - Oil Pump
c - Oil Inlet
d - Bleed Screw



52044

a - Oil Pump
b - Apply 2-4-C w/Teflon to Shaft
c - Driven Gear
d - Bushings
e - O-Rings

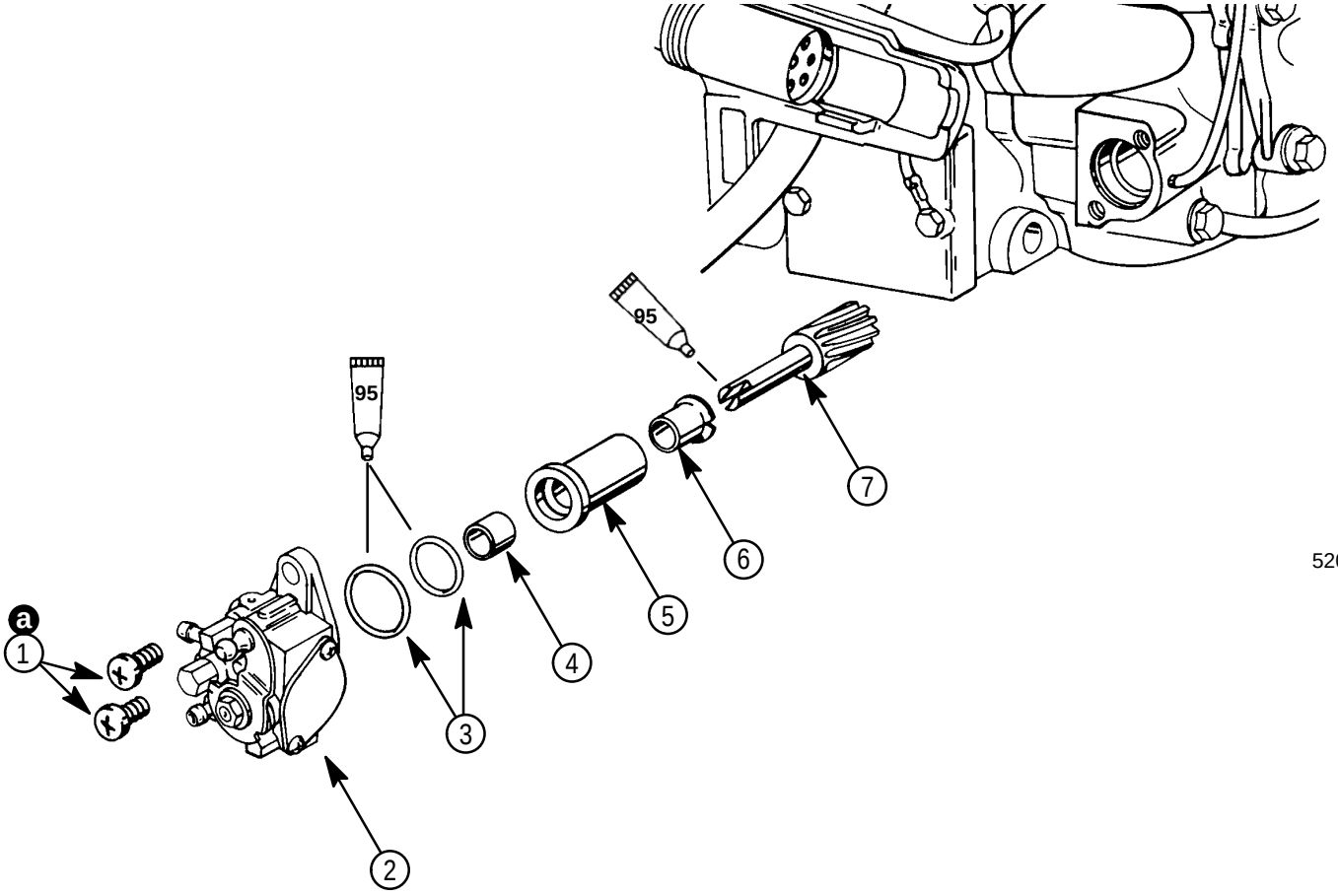
Pump Drive System (Variable Ratio Oil Pump)



52044

a - O–Rings
b - Driven Gear
c - Drive Gear
d - Crankshaft
e - Oil Pump

Oil Pump to Powerhead Assembly (Variable Ratio Oil Pump)



52046

95 2-4-C With Teflon (92-825407A12)

TORQUE SPECIFICATIONS

a 60 lb. in. (7.0 N·m)

1 - Bolt
2 - Oil Pump
3 - O-Rings
4 - Bushing
5 - Bearing
6 - Bushing
7 - Driven Gear

Set Up Instructions for Oil Injection System

⚠ CAUTION

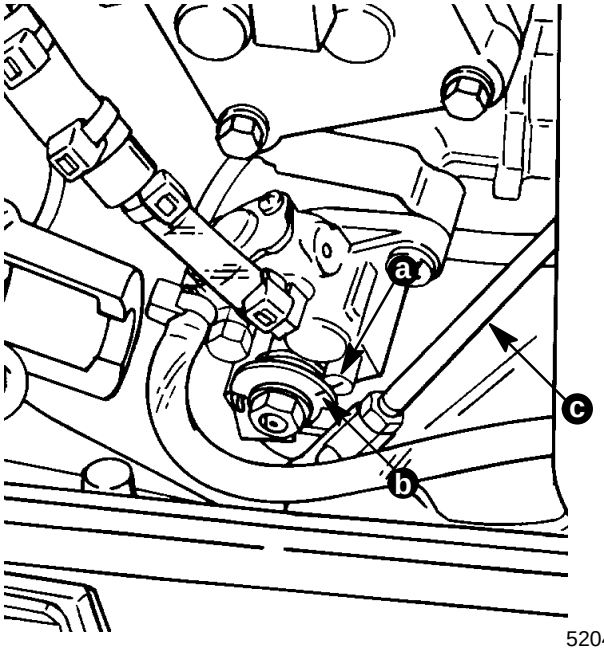
During break-in, engine must be run on a 25:1 gasoline/oil ratio (50:1 mixed oil/fuel ratio in fuel tank plus 50:1 ratio from oil pump) for the first 15 gallons of fuel. Refer to engine break-in procedure in the Operation and Maintenance Manual.

⚠ CAUTION

If using an electric fuel pump, fuel pressure must not exceed 4 psi (27.4 kPa). If necessary, install a pressure regulator between electrical fuel pump and engine. Set at 4 psi maximum.

Carburetor/Oil Pump Synchronization (Variable Ratio Oil Pump)

While holding throttle arm at idle position, adjust length of link rod so that stamped mark of oil pump body aligns with stamped mark of oil pump lever, and lever is in closed position.



52047

a - Mark on Body
b - Mark on Lever
c - Link Rod

Filling Oil Injection System with Oil

Quicksilver 2-Cycle Outboard Oil is recommended for this oil injection system. In an emergency, whin Quicksilver oil is not available, substitute a high quality 2-cycle outboard oil that meets BIA ratings TC-W and TC-WII, shown on oil container. BIA ratings, TC-W and TC-WII are the Boating Industry Association's designation for approved 2-Cycle water-cooled outboard oils.

Bleeding Air From Oil Injection System

⚠CAUTION

If air exists in either oil pump hose (inlet or outlet), the air MUST BE bled from hose(s) or engine damage may occur.

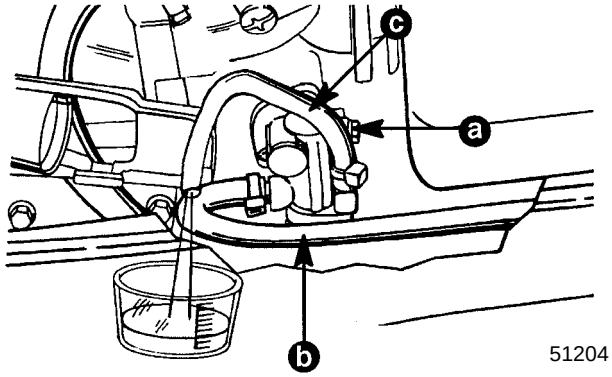
BLEEDING AIR FROM OIL PUMP INLET HOSE

With engine not running, place a shop towel below oil pump. Loosen bleed screw three to four turns and allow air bubbles to exit inlet hose. Torque bleed screw to 25 lb. in. (3.0 N·m). This procedure also allows oil pump to fill with oil.

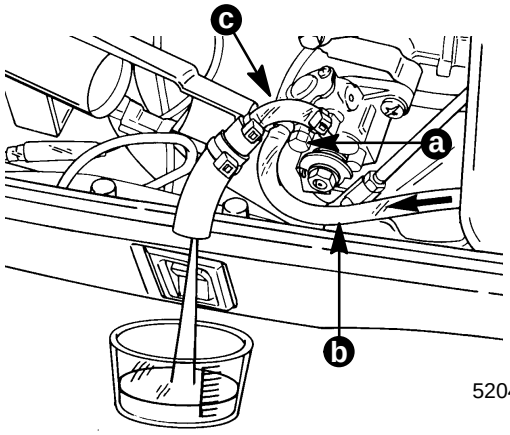
BLEEDING AIR FROM OIL PUMP OUTLET HOSE

1. Purge air from outlet hose by running engine (on 50:1 gasoline/oil mixture in fuel tank) at idle speed until no air bubbles are present in outlet hose.

Fixed Ratio Oil Pump



Variable Ratio Oil Pump



a - Bleed Screw
b - Inlet Hose
c - Outlet Hose

Outboard Operation

1. Check oil level in oil tank.
2. A 50:1 gasoline/oil mixture must be used during break-in or after extended storage.
3. Check warning horn operation.

Turning the key from the “off” to “on” position (engine not running) will momentarily trigger the warning horn. This alerts you the warning system is functional. If the warning horn does not sound or stays on when the key is in the “on” position, refer to oil injection system troubleshooting chart following to correct the problem.

The oil injection warning sound is an intermittent “beep”, “beep”, “beep”, etc. The overheat warning sound is a continuous “beep” .

Check Operation of the Oil Injection System (Engine Running)

1. Operate engine following the break-in procedure outlined in the Operation and Maintenance Manual.

If warning horn should sound and intermittent “beep”, “beep”, “beep” during operation, a problem may be occurring in the oil injection system. Refer to troubleshooting following.

Required Side Mount Remote Control or Ignition Key Switch Assembly

Boats Equipped with a Side Mount Remote Control

A Quicksilver Commander Series Side Mount Remote Control equipped with a warning horn, must be used with this outboard. This warning horn is necessary for both the oil injection warning system and the engine overheat warning system.

Boats Equipped with Panel or Console Mount Remote Controls

A Quicksilver Ignition Key/Choke Assembly equipped with a warning horn is necessary for both the oil injection warning system and the engine overheat warning system.

Oil Injection System Troubleshooting Chart

Troubleshooting the Oil Injection System

If a problem occurs with the oil injection system and the warning horn sounds in a intermittent manner, stop engine and check if problem is caused by (1) low oil Level, or (2) a faulty warning sensor of module.

Troubleshooting Chart

Problem: Warning Horn Does Not Sound When Ignition Key is Turned to "ON" Position.

Possible Cause	Corrective Action
Horn malfunction or open (tan/blue) wire between horn and engine.	Disconnect tan/blue warning module lead (engine overheat sensor) located in cylinder head. Use a jumper wire to ground tan/blue warning module lead to engine ground. Warning horn should sound. If not, check tan/blue wiring between engine and warning horn for open circuit. Check horn.
Faulty Warning Module	Check if all warning module leads are connected
Using incorrect side mount remote control or ignition/ choke assembly.	See info above

Problem: Warning Horn Stays On When Ignition Key is Turned to "ON" Position (Engine Cold).

Possible Cause	Corrective Action
Faulty Engine overheat sensor.	If warning horn sounds a continuous "beep", the engine overheat sensor may be faulty. Disconnect tan/blue overheat sensor lead at bullet connection. Turn ignition key to "ON" position. If horn stops sounding, the engine overheat sensor is faulty.
Faulty Warning Module	Check connections-replace module.

Problem: Warning Horn Sounds (Intermittent Beep) When Engine is Running and Oil Tank is Full.

Possible Cause	Corrective Action
Defective low oil sensor (located in bottom of oil tank).	Disconnect both low oil sensor leads (blue) at bullet connections. Connect an ohmmeter between sensor leads. There should be no continuity through sensor. If continuity exists, sensor is faulty

If all of the checks are positive, the Warning Module is faulty. Replace Module and re-test.

1. Check oil level in oil tank. If oil level is approximately 14.5 fl. oz. (435 ml) or less, the problem is low oil level. Add oil to oil tank.

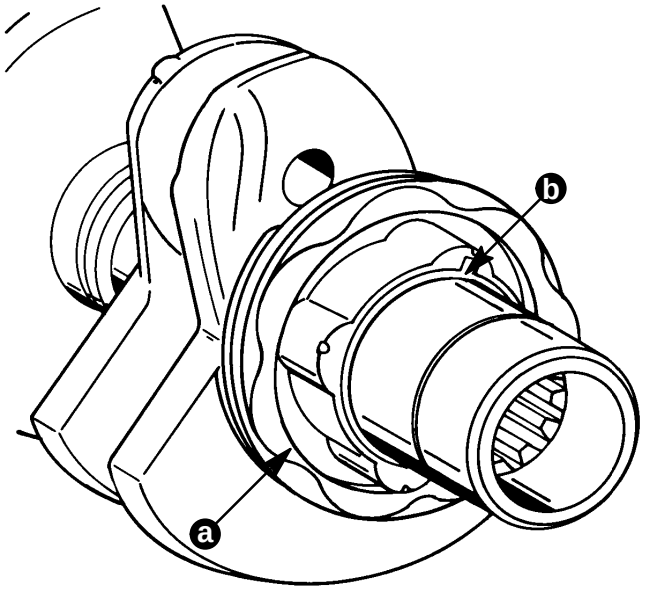
NOTE: *There is a safety reserve of oil left in the oil tank after the low oil warning is sounded that allows enough oil for approximately 1.5 hours of full throttle operation.*

2. If there is more than approximately 14.5 fl. oz. (435 ml) of oil remaining in tank, then the problem may be a faulty low oil warning sensor or a faulty warning module. Refer to troubleshooting chart following.

Installing Drive Gear (For Oil Injection Pump) Onto Crankshaft

1. Refer to Section 4A (Powerhead) for proper disassembly of components.
2. Inspect gear teeth for damage. Replace gear if any of these problems exist:

   ***Excessive Wear**
   ***Cracks in hub or rear (Do Not mistake plastic flow lines for cracks)**
   ***Distorted Teeth**



51084

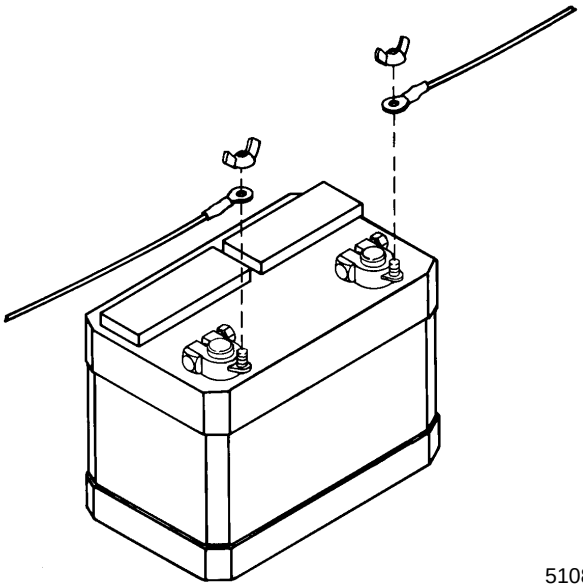
a - Oil Drive Gear
b - Key

3. Refer to Section 4 (POWERHEAD) for proper reassembly of components.

Oil Warning Module

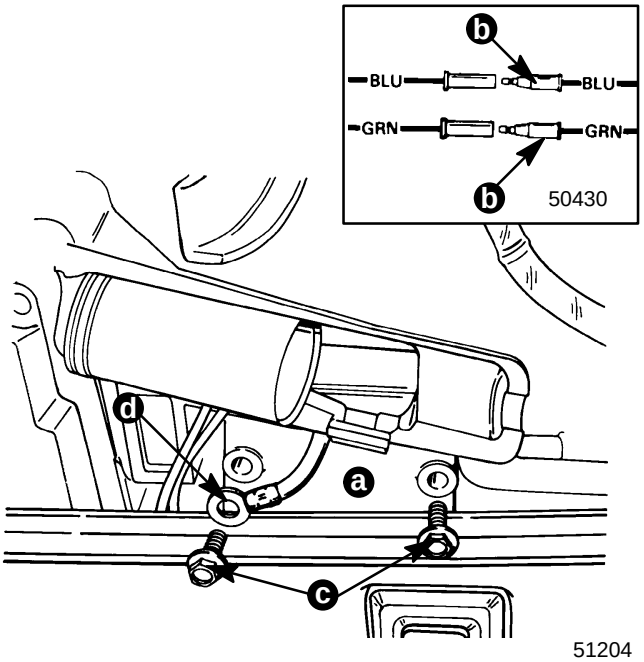
Removal/Installation

1. Disconnect battery cables.



51084

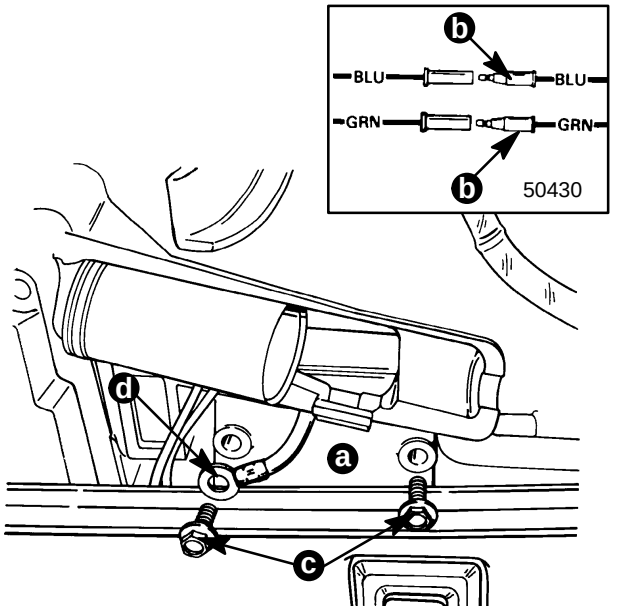
2. Disconnect warning module PURPLE, TAN and both BLUE leads at bullet connectors. Remove warning module from lower cowl.



51204

a - Warning Module
b - Warning Module Leads
c - Screws
d - Ground Wire

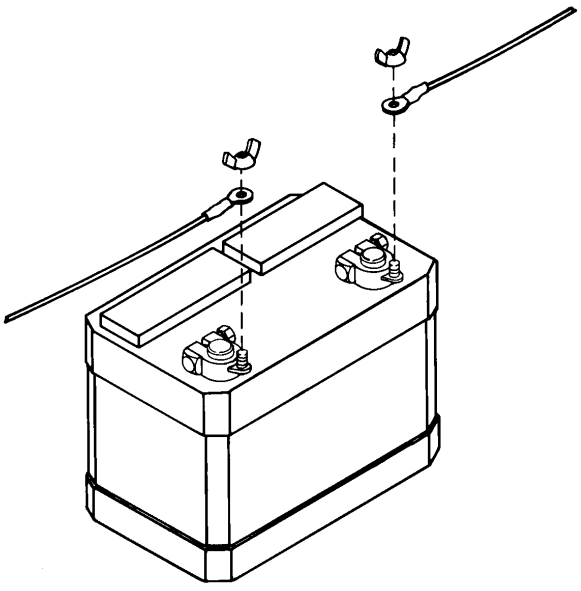
3. Connect PURPLE, TAN and both BLUE leads at respective bullet connectors. Secure warning module BLACK lead to switch box mounting bolt and install warning module.Tighten bolts securely.



51204

a - Warning Module
b - Warning Module Leads
c - Screws
d - Ground Wire (BLACK)

4. Re-connect battery cables.

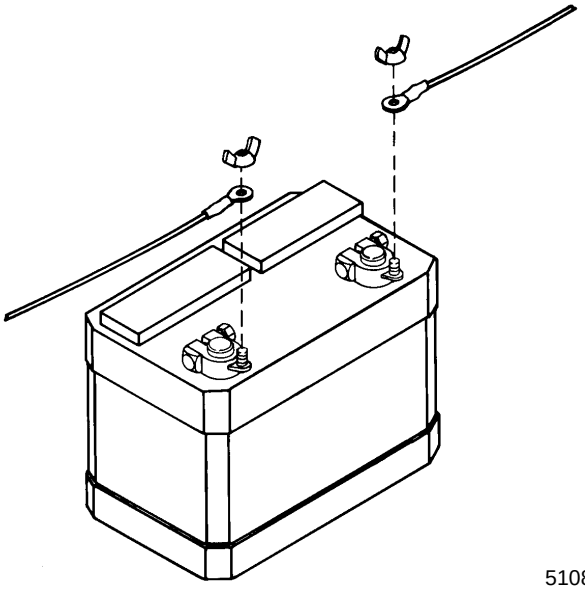


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Engine Mounted Oil Reservoir

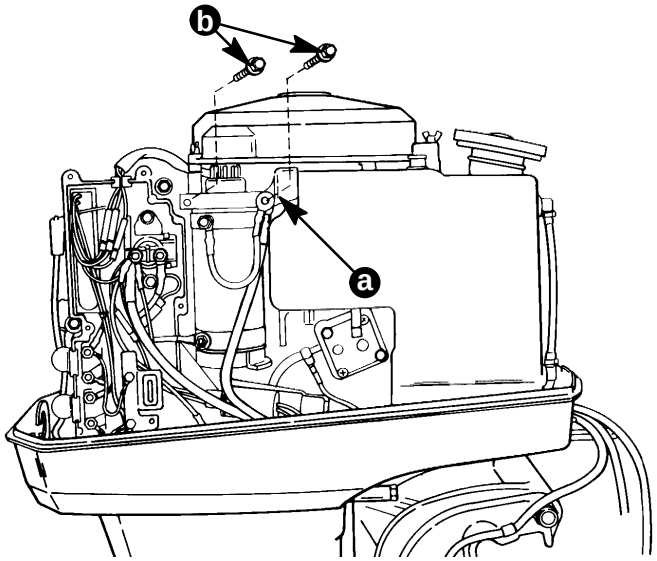
Removal

1. Disconnect battery cables.



51084

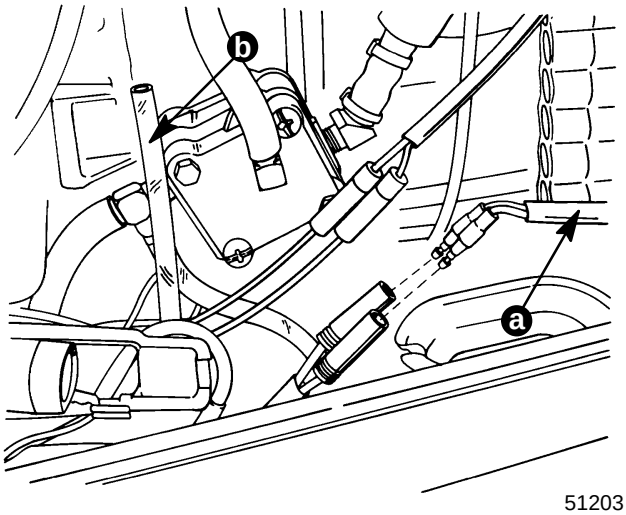
2. Remove starter/oil bracket.



51080

a - Starter Bracket
b - Bolts

3. Disconnect oil hose and low oil sensor wires (BLUE) at bullet connectors. Remove oil reservoir.



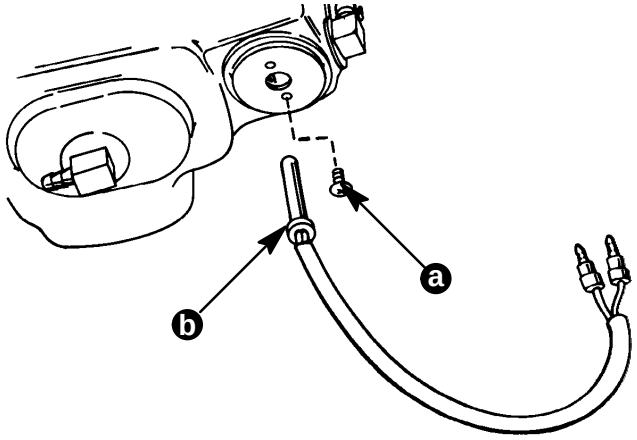
51203

a - Oil Tank Wires (BLUE)
b - Oil Hose

4. Remove oil level sensor from oil reservoir.

⚠ CAUTION

Oil level sensor is FRAGILE. Handle with care.

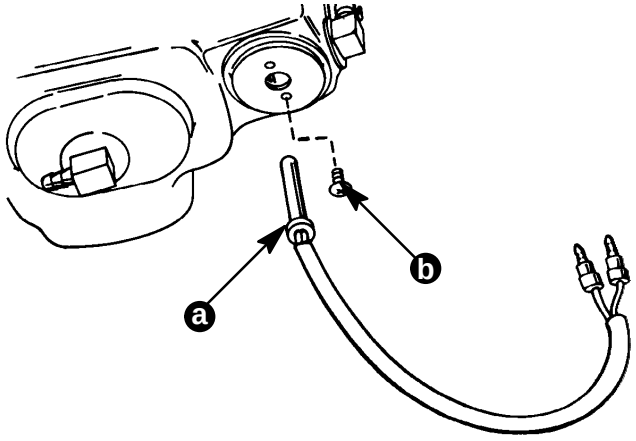


51204

a - Screw
b - Oil Level Sensor

Installation

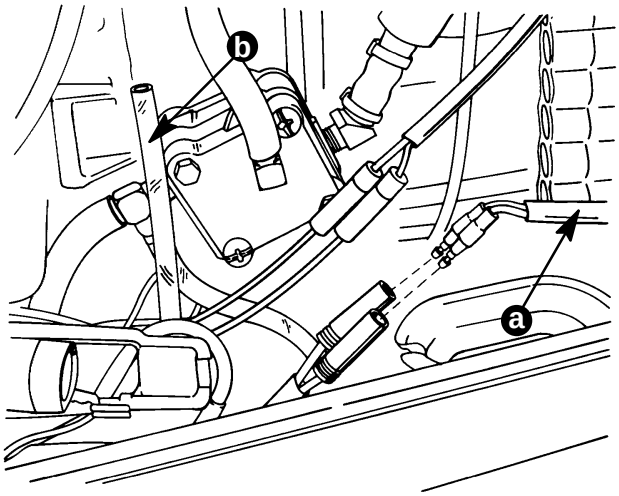
1. Install oil level sensor and secure in place.



51204

a - Oil Level Sensor
b - Screw (Tighten Securely)

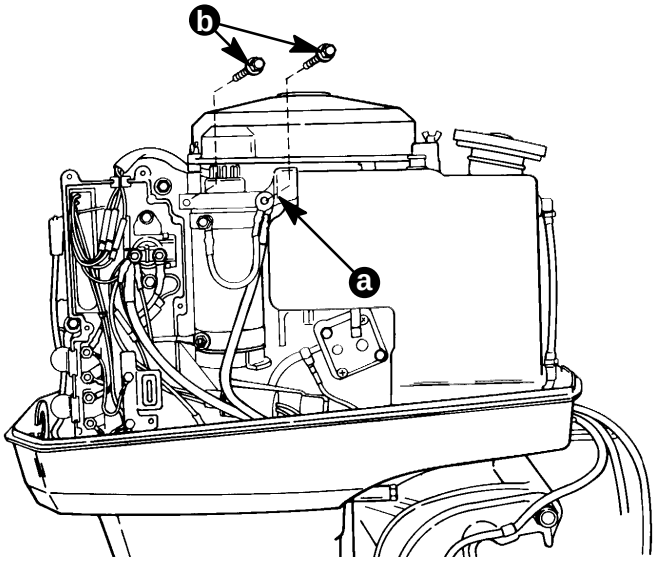
2. Connect sensor oil level wires (BLUE) at bullet connectors. Re-connect oil hose and secure in place with stay strap. Install reservoir to outboard.



51203

a - Oil Level Sensor Wires
b - Oil Hose

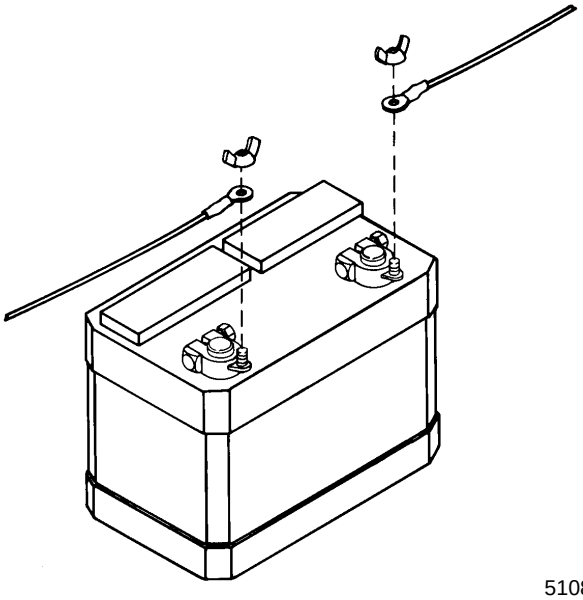
3. Install starter/oil tank bracket.



51080

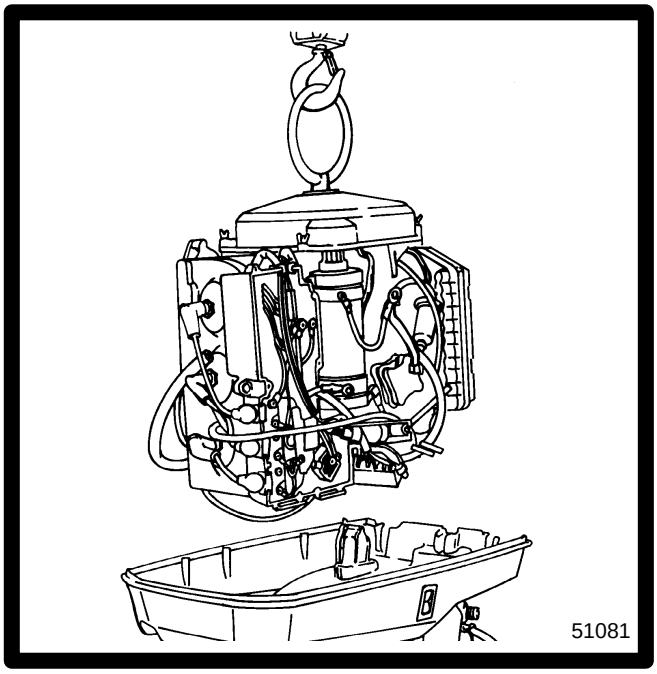
a - Starter/Oil Tank Bracket
b - Bolts

4. Re-connect battery cables.



51084

POWERHEAD



4

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Specifications

General	
Type	Two-Stroke Cycle
Displacement	51.8 cu. in. (849 cc)
Cylinder Bore	
Diameter Standard	2.955 in. (75.057 mm)
Diameter .015 Oversize	2.970 in. (75.438 mm)
Diameter .030 Oversize	2.985 in. (75.819 mm)
Out of Round (Max.)	0.003 in. (0.08 mm)
Taper (Max.)	0.003 in. (0.08 mm)
Piston	
Diameter Standard	2.950 in. (74.93 mm)
Diameter .015 Oversize	2.965 in. (75.31 mm)
Diameter .030 Oversize	2.980 in. (75.69 mm)
Piston Ring	
End Gap	0.010 in. – 0.018 in. (.254 mm – .457 mm)
Crankshaft	
Runout (Max.)	0.002 in. (0.05 mm)

Special Tools

Part No.	Description
91-52344	Flywheel Holder
91-24161	Protector Cap
91-73687A1	Flywheel Puller
91-90455	Lifting Eye
*91-24697	Piston Ring Expander
91-74607A2	Piston Pin Tool
91-77109A1	Lockring Installation Tool
*91-32610	Torque Wrench (0 – 200 lb. ft.) (0 – 27 N·m)
*91-66274	Torque Wrench (0 – 150 lb. ft.) (0 – 20 N·m)
91-25821A1	Powerhead Stand

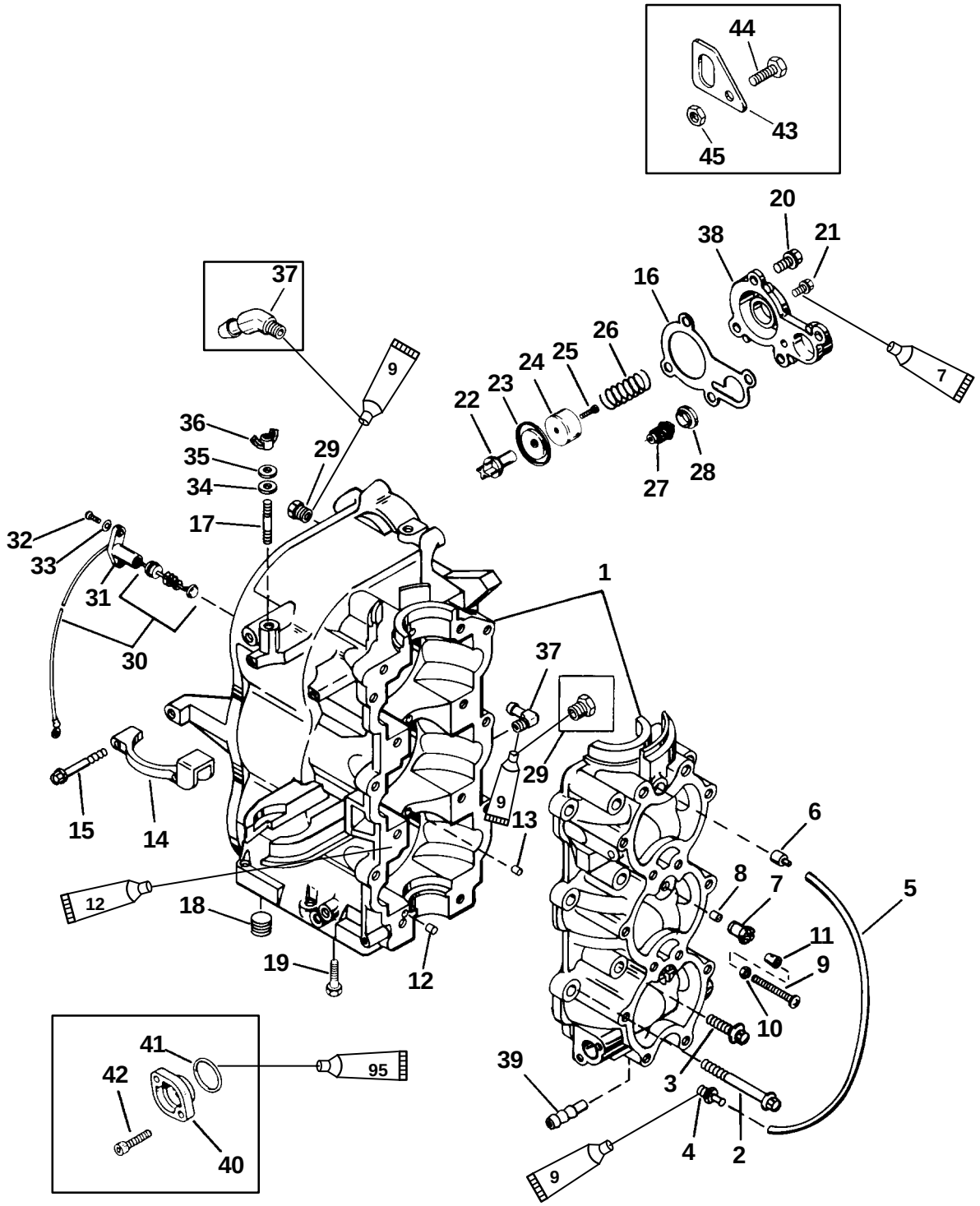
*May be obtained locally

Quicksilver Lubricants and Service Aids

Part No.	Description
92-32609-1	Loctite 271 Grade “A”
92-12564--1	Master Gasket Sealant
92-42649A1	Needle Bearing Assembly Lubricant
92-13249A24	2 Cycle Outboard Oil
92-59327-1	Loctite Primer “T”
92-90018A12	2-4-C Marine Lubricant
92-34277-1	Perfect Seal
*	Loctite 272

*May be obtained locally

Cylinder Block and Crankcase



7 Loctite 271 (92-809820)

9 Loctite PST Pipe Sealant (92-809822)

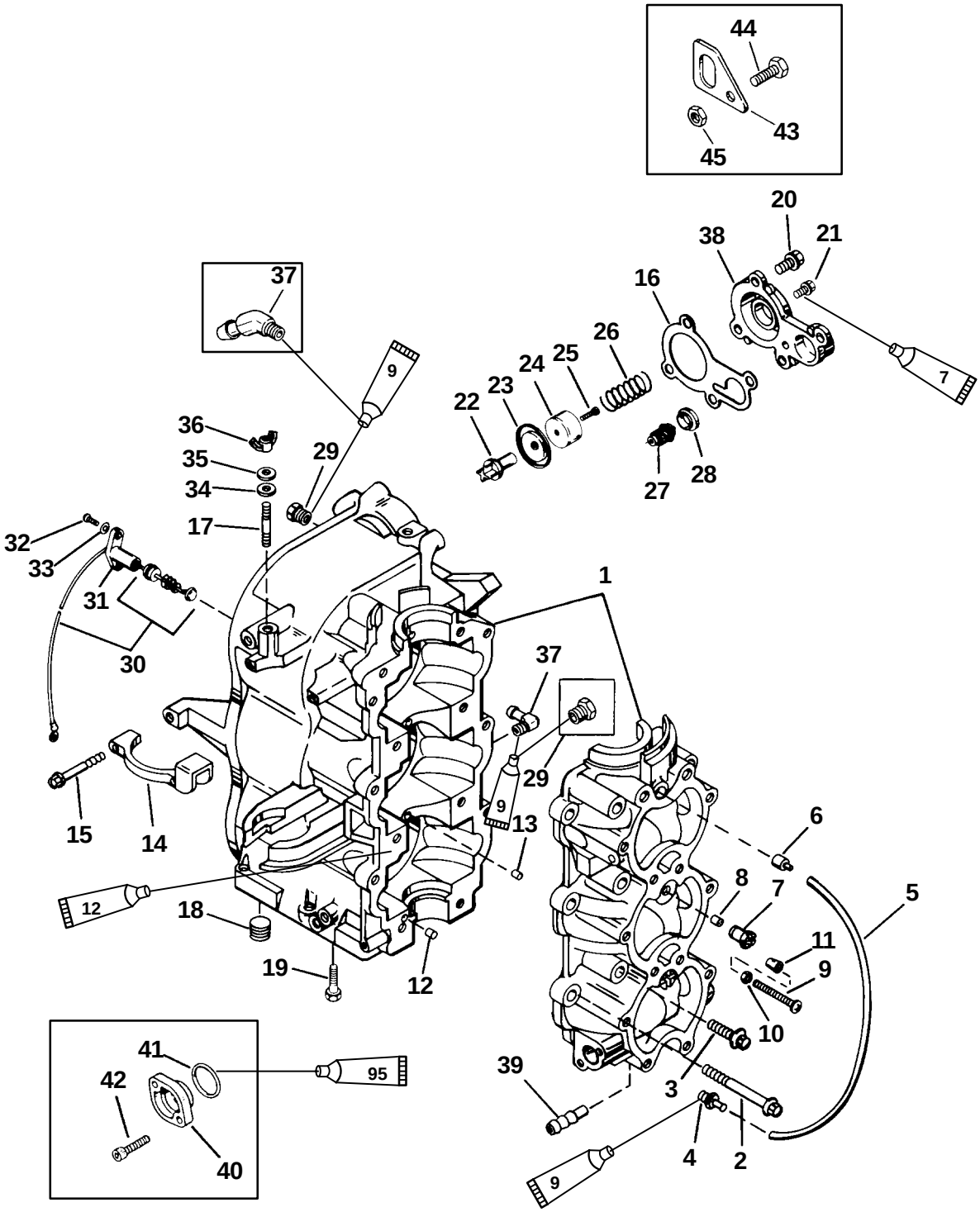
12 Loctite Master Gasket (92-12564-2)

95 2-4-C With Teflon (92-825407A12)

Cylinder Block and Crankcase

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	CYLINDER BLOCK			
2	8	SCREW	220	18.5	25.0
3	6	SCREW	220	18.5	25.0
4	1	CHECK VALVE			
5	1	HOSE (16″)			
6	1	CHECK VALVE (PRESS-IN)			
7	2	CARRIER ASSEMBLY			
8	2	CHECK VALVE			
9	1	ADJUSTING SCREW			
10	1	JAM NUT			
11	1	CAP			
12	1	DOWEL PIN (LOCATING)			
13	3	DOWEL PIN (BEARING RACE)			
14	1	COVER			
15	2	SCREW	220	18.5	25.0
16	1	GASKET			
17	2	STUD			
18	4	PIPE PLUG			
19	6	SCREW	350	29.0	39.5
20	4	SCREW (25MM - Qty. of 3 on 55)	220	18.5	25.0
21	1	SCREW (55)	Drive Tight		
22	1	POPPET VALVE			
23	1	DIAPHRAGM			
24	1	WASHER			
25	1	SCREW **50/60**	Drive Tight		
26	1	SPRING			
26	1	SPRING **(60 Pontoon/Big Foot)**			
27	1	THERMOSTAT (120°)			
28	1	GASKET			

Cylinder Block and Crankcase



7 Loctite 271 (92-809820)

9 Loctite PST Pipe Sealant (92-809822)

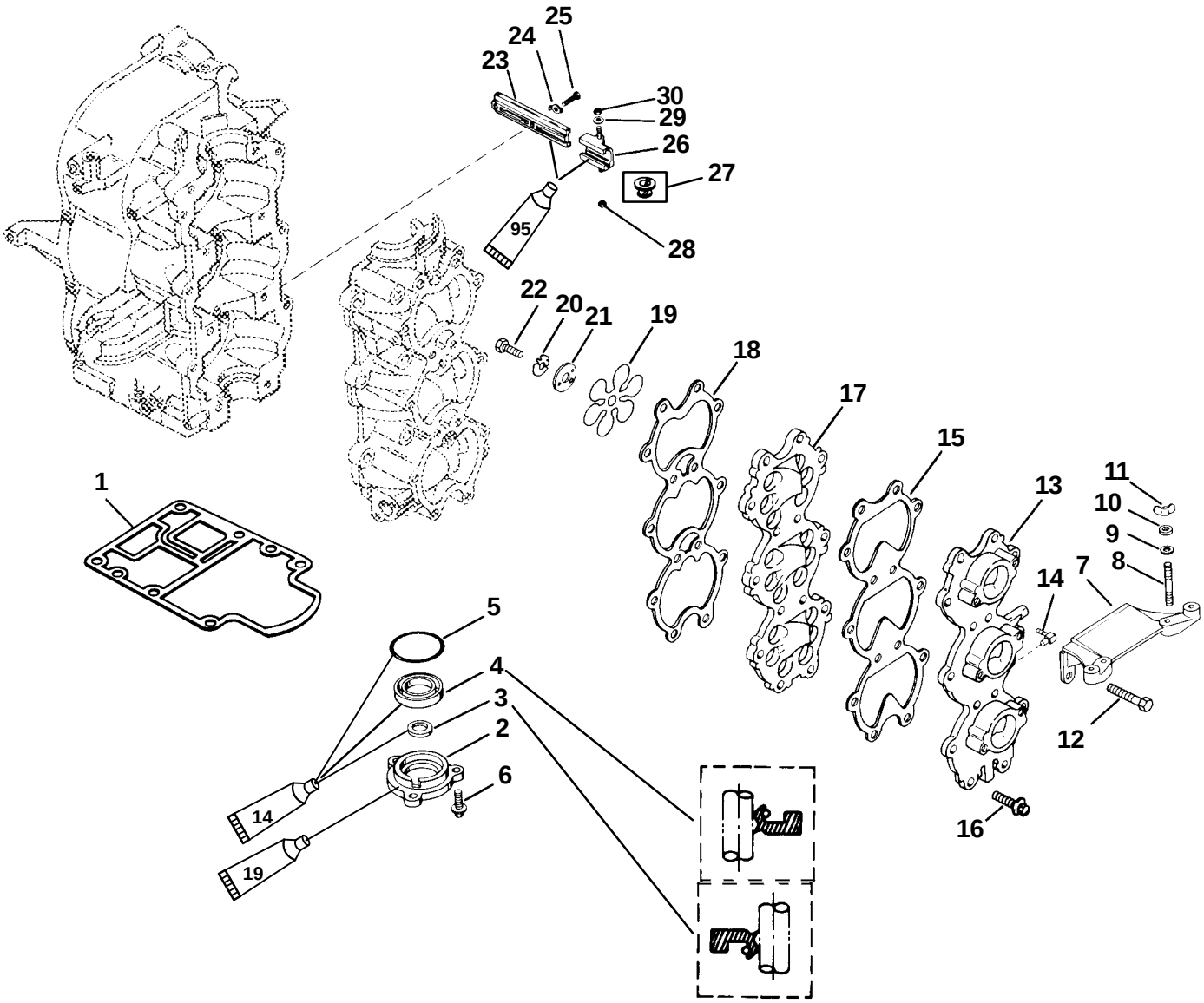
12 Loctite Master Gasket (92-12564-2)

95 2-4-C With Teflon (92-825407A12)

Cylinder Block and Crankcase

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
29	1	PIPE PLUG	Drive Tight		
30	1	TEMPERATURE SENDER			
31	1	RETAINER			
32	1	SCREW	Drive Tight		
33	1	WASHER			
34	2	WASHER			
35	2	WASHER			
36	2	WING NUT **50/60**	Hand Tight		
37	1	ELBOW			
37	1	ELBOW **(55)**			
38	1	COVER			
39	1	FITTING **(50/60)**			
40	1	COVER			
41	1	O-RING **55**			
42	2	SCREW	60		7.0
43	1	LIFTING EYE			
44	1	SCREW **(55MM)**	220	18.5	25.0
45	1	NUT	Drive Tight		

Induction Manifold and Reed Block



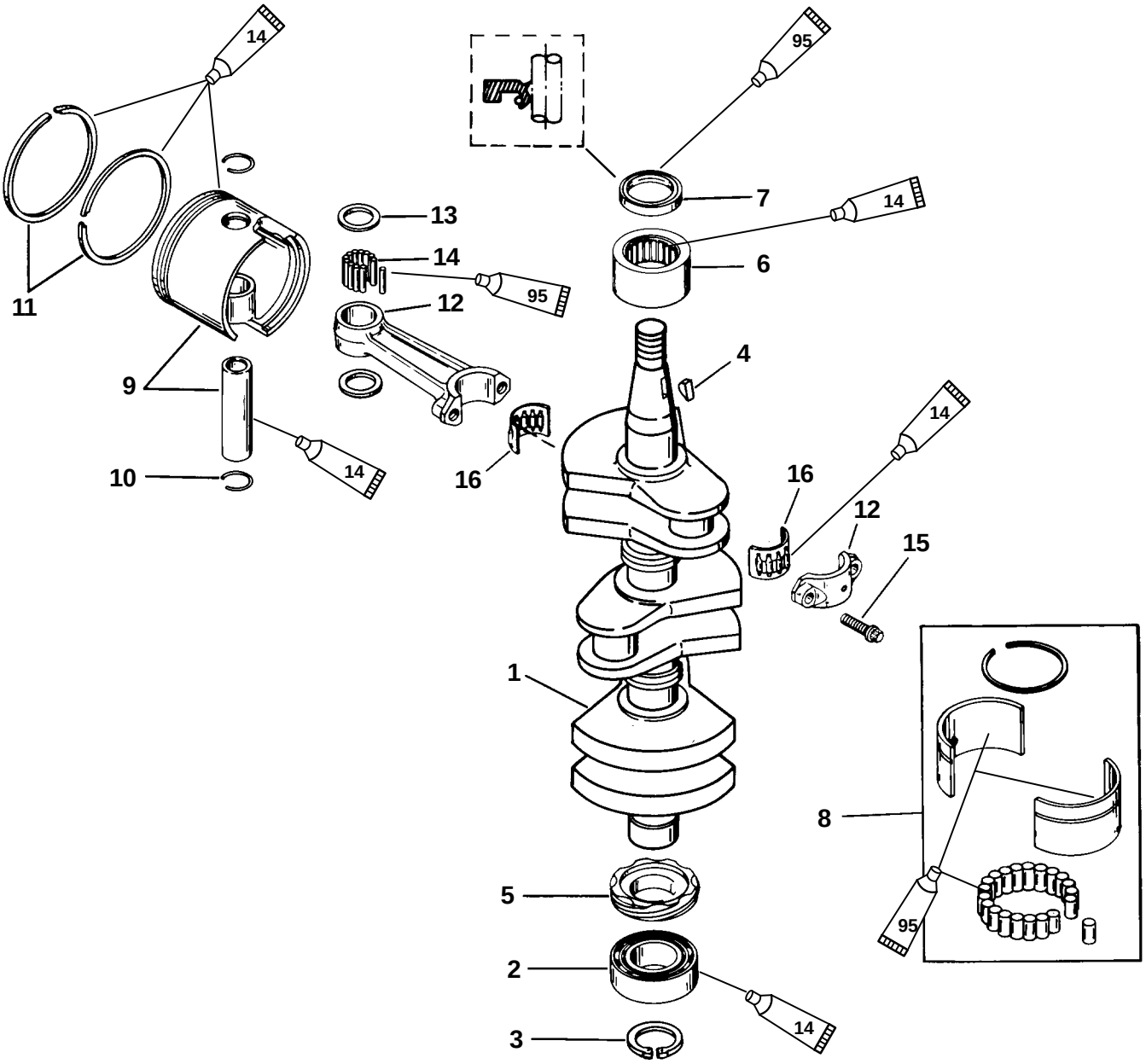
14 2 Cycle Outboard Oil (92-13249A24)

19 Perfect Seal (92-34227-1)

Induction Manifold and Reed Block

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	GASKET			
2	1	LOWER END CAP ASSEMBLY			
3	1	OIL SEAL			
4	1	OIL SEAL			
5	1	O-RING			
6	3	SCREW	220	18.5	25.0
7	1	BRACKET ASSEMBLY			
8	2	STUD			
9	2	WASHER			
10	2	WASHER **50/60**			
11	2	WING NUT	Hand Tight		
12	4	SCREW	220	18.5	25.0
13	1	INDUCTION MANIFOLD			
14	1	ELBOW **(Qty. of 2 on 55)**			
15	1	GASKET			
16	10	SCREW	220	18.5	25.0
17	1	REED BLOCK ASSEMBLY			
18	1	GASKET			
19	3	REED SET **(0.008 THICK)**			
19	3	REED SET **(0.010 THICK)**			
20	3	TAB WASHER			
21	3	RETAINER			
22	3	SCREW	60		7.0
23	1	SHIFT RAIL			
24	2	TAB WASHER			
25	2	SCREW	165	14.0	18.5
26	1	SLIDE			
27	1	NYLINER			
28	1	NUT	Drive Tight		
29	1	WASHER			
30	1	NUT	Drive Tight		

Crankshaft, Pistons and Connecting Rods



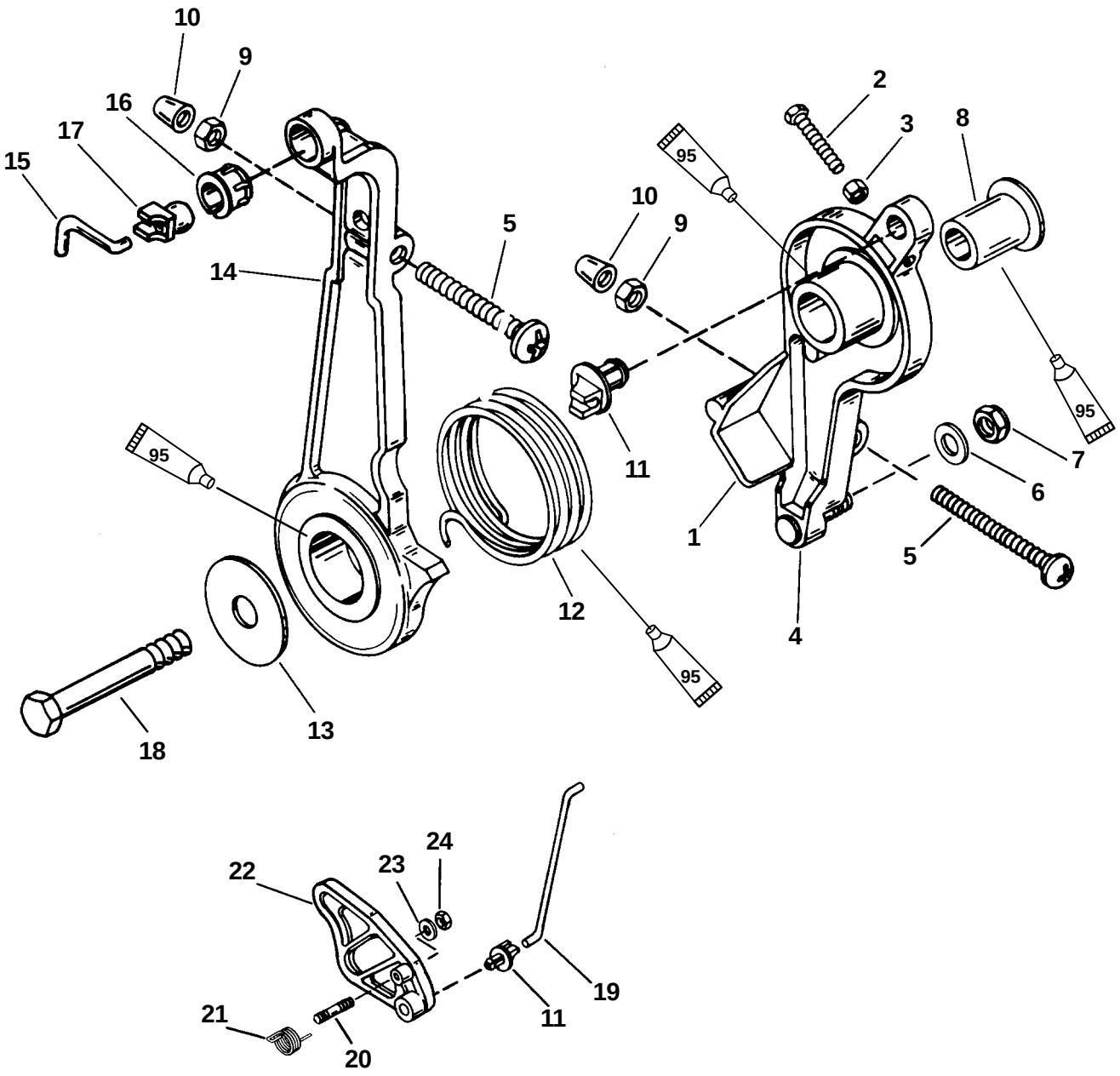
14 2 Cycle Outboard Oil (92-13249A24)

95 2-4-C With Teflon (92-825407A12)

Crankshaft, Pistons and Connecting Rods

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	CRANKSHAFT ASSEMBLY			
2	1	BALL BEARING			
3	1	RETAINING RING			
4	2	KEY			
5	1	DRIVER GEAR			
6	1	ROLLER BEARING ASSEMBLY **(TOP)**			
7	1	OIL SEAL			
8	2	ROLLER BEARING ASSEMBLY **(CENTER)**			
9	3	PISTON ASSEMBLY **(STANDARD)**			
9	AR	PISTON ASSEMBLY **(.015 O.S.)**			
9	AR	PISTON ASSEMBLY **(.030 O.S.)**			
10	6	LOCK RING			
11	1	PISTON RING **(STANDARD)**			
11	AR	PISTON RING **(.015 O.S.)**			
11	AR	PISTON RING **(.030 O.S.)**			
12	3	CONNECTING ROD ASSEMBLY			
13	6	WASHER			
14	87	NEEDLE BEARING			
15	6	SCREW	1st Torque – 15 lb. in. (1.5 N·m) 2nd Torque – 1/4″ Bolt – 120 lb. in. (13.5 N·m) + an additional 1/4 turn 5/16″ Bolt – 27 lb. ft. (36.5 N·m)		
16	3	ROLLER BEARING			

Throttle Lever and Linkage



95 2-4-C With Teflon (92-825407A12)

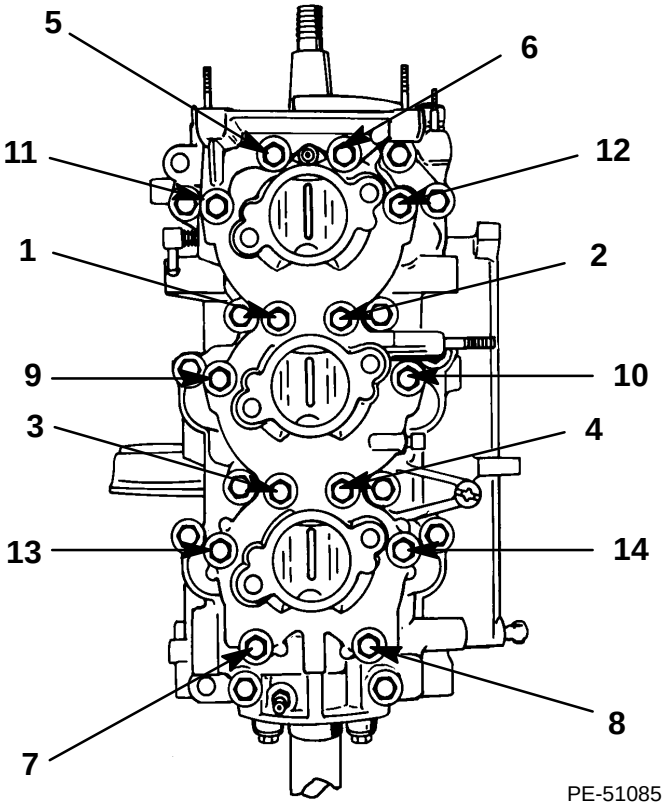
Throttle Lever and Linkage

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	THROTTLE LEVER			
2	1	ADJUSTING SCREW			
3	1	JAM NUT			
4	1	PIN			
5	2	ADJUSTING SCREW			
6	1	WASHER			
7	1	NUT	Drive Tight then Back Off 1/2 Turn		
8	1	BUSHING			
9	2	JAM NUT			
10	2	CAP			
11	2	SWIVEL BUSHING			
12	1	SPRING			
13	1	WASHER			
14	1	SPARK ADVANCE LEVER			
15	1	SPARK ADVANCE ROD			
16	2	SWIVEL BASE			
17	2	SWIVEL BALL			
18	1	SCREW	Drive Tight		
19	1	THROTTLE ROD			
20	1	STUD			
21	1	SPRING			
22	1	THROTTLE CAM			
23	1	WASHER			
24	1	NUT	Drive Tight then Back Off 1/2 Turn		

Powerhead Torque Sequence

INTAKE MANIFOLD TORQUE SEQUENCE

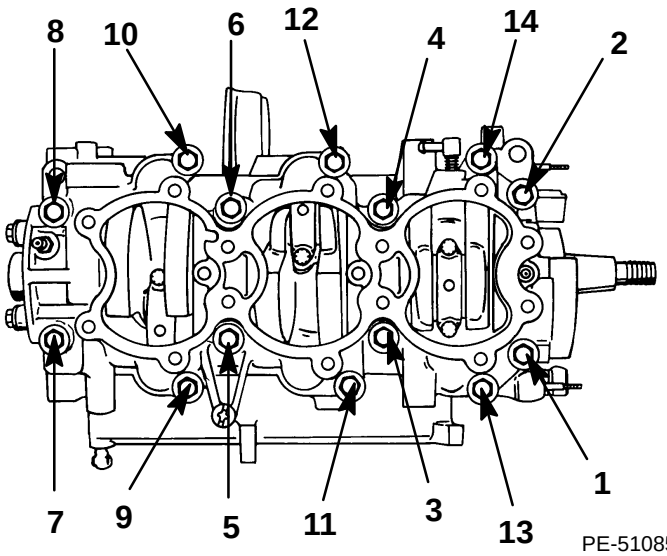
Install bolts and torque to 18 lb. ft. (24.5 N·m)



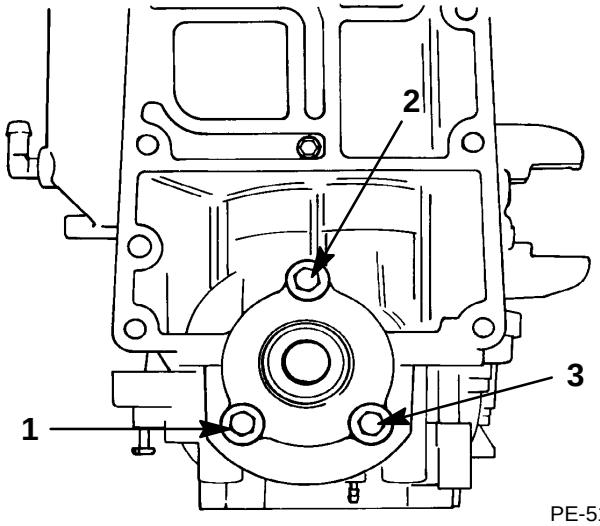
PE-51085

CRANKCASE COVER AND LOWER END CAP COVER TORQUE SEQUENCE

Torque bolts to 18 lb. ft. (24.5 N·m)



PE-51085



PE-51086

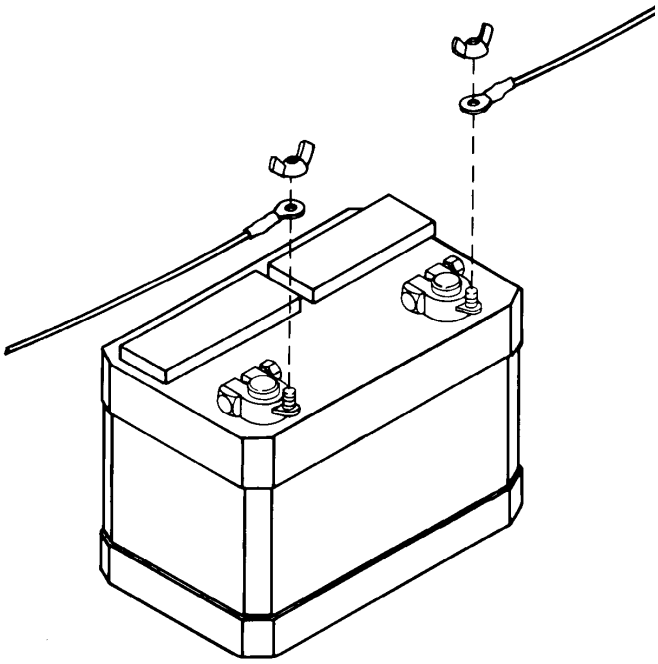
General Information

Powerhead “Disassembly” and “Reassembly” instructions are printed in a sequence that should be followed to assure best results when removing or replacing powerhead components. If complete disassembly is not necessary, start reassembly at point disassembly was stopped. Refer to “Table of Contents” preceding.

If major powerhead repairs are to be performed, remove powerhead from drive shaft housing as an assembly. Remove external engine components referring to appropriate section of service manual.

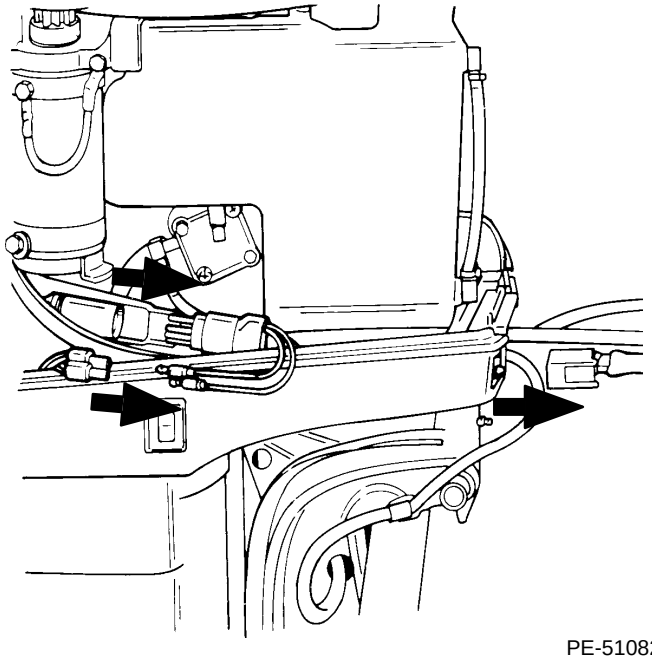
ELPTO MODEL

1. Remove battery cables.



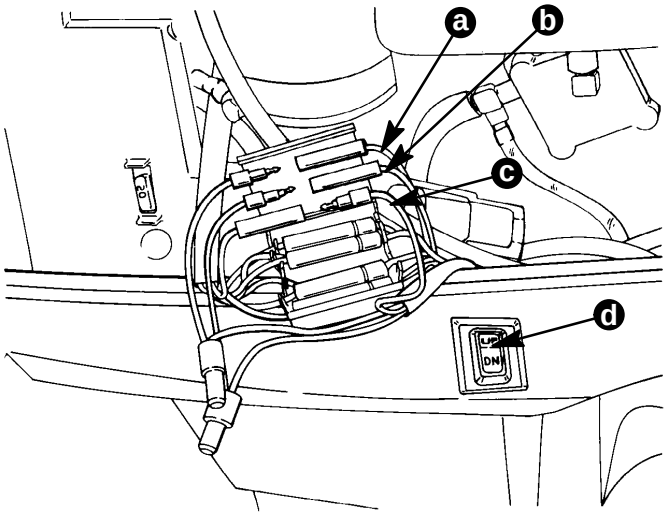
PE-51084

2. Disconnect control/trim harness and fuel line.



PE-51082

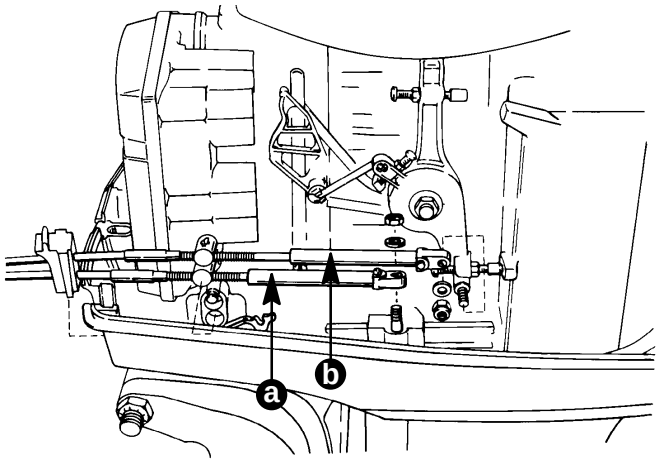
3. Disconnect trim switch and trim relay wires.



PE-51089

a - Blue/White
b - Green/White
c - Red/Black
d - Trim Switch

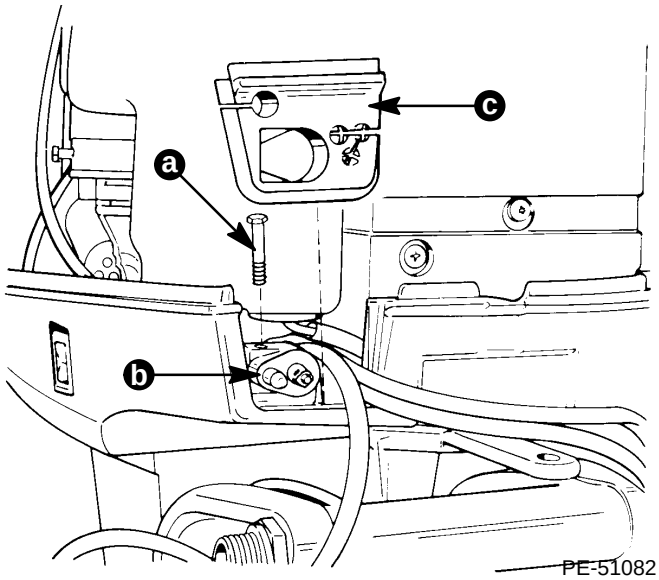
4. Remove control cables.



PE-51088

a - Shift Cable
b - Throttle Cable

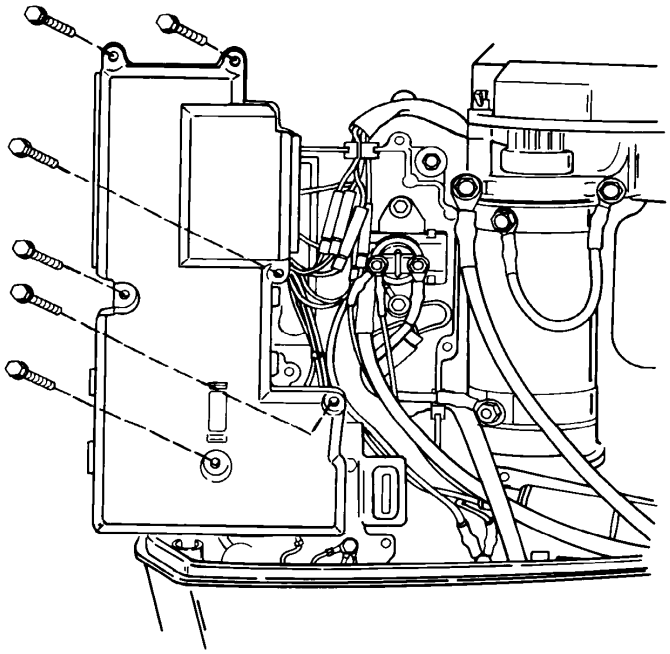
5. Remove bolt and rubber grommet.



PE-51082

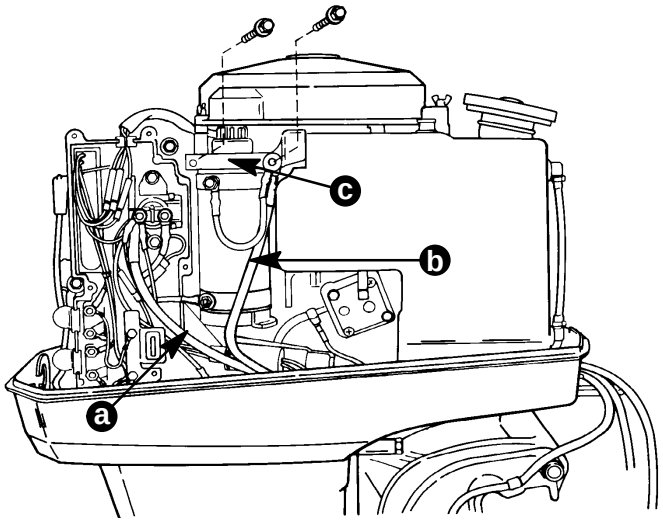
a - Bolt
b - Fuel Connector
c - Rubber Grommet

6. Remove electrical box cover.



PE-51089

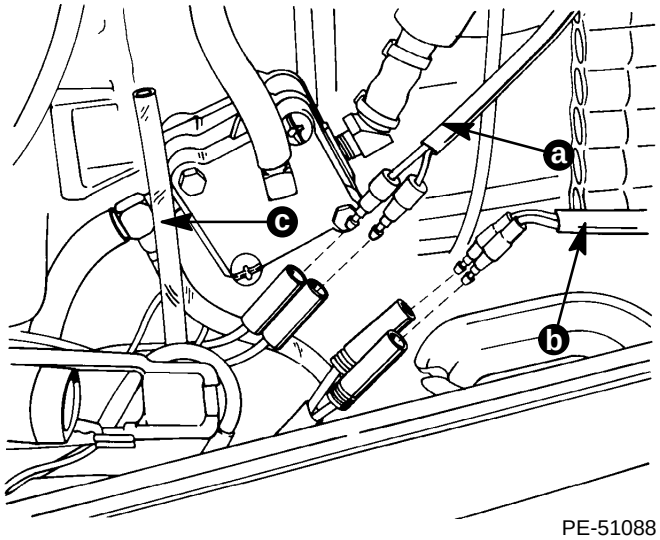
7. Remove battery cables and starter bracket.



PE-51080

a - Positive Cable
b - Ground Cable
c - Bracket

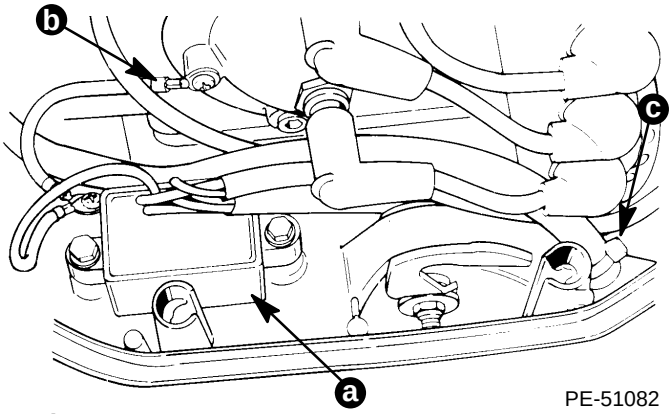
8. Disconnect wires and remove oil tank.



PE-51088

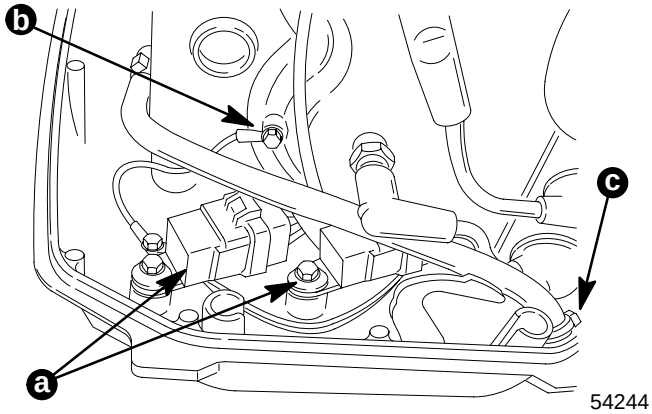
a - Oil Tank Wires (Blue)
b - Power Trim Wires (Blue/White) and (Green/White)
c - Oil Hose (From Tank)

9. Remove ground wire to powerhead. Disconnect wires from trim relay module(s). Disconnect tel tale hose



PE-51082

Design 1

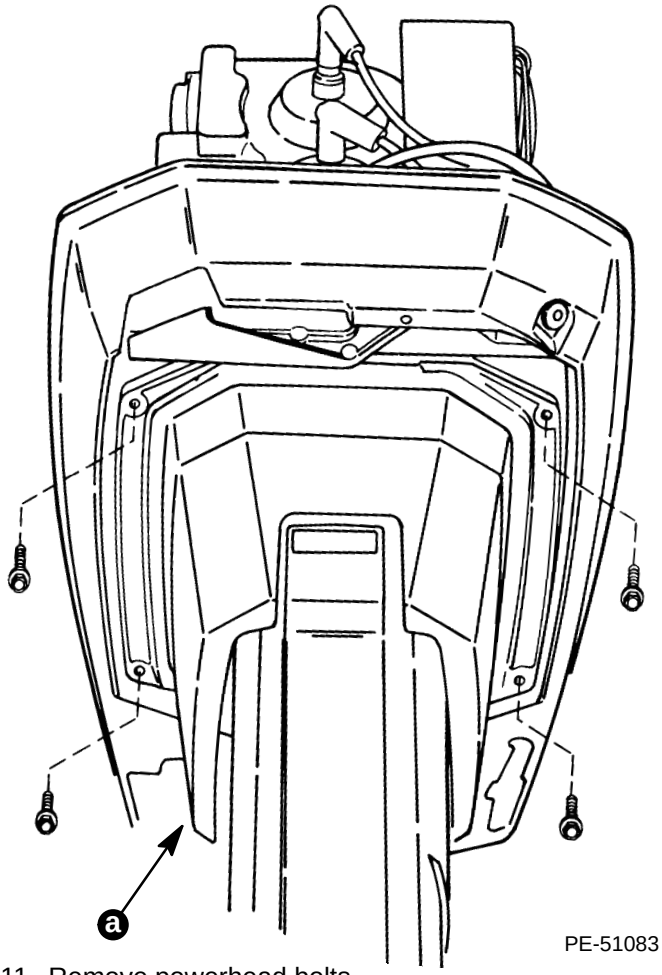


54244

Design 2

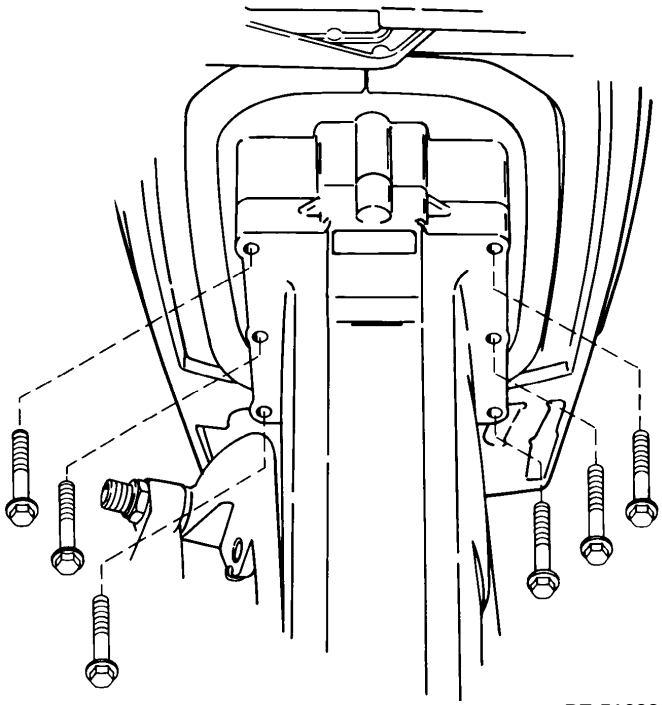
a - Trim Relay Module(s)
b - Ground Lead
c - Tel Tale Hose

10. Remove cover (a).



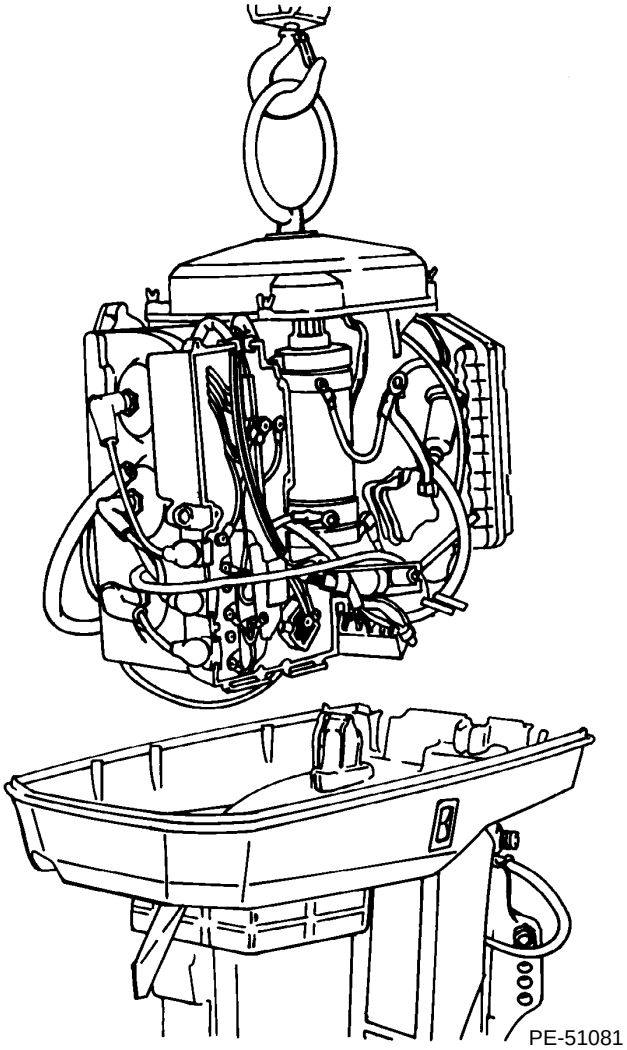
PE-51083

11. Remove powerhead bolts.



PE-51088

12. Install lifting eye (p/n 91-90455) into flywheel a minimum of five turns. Lift powerhead from drive shaft housing allowing shift linkage to slide off shift rail guide.



PE-51081

Powerhead Disassembly

Removing Engine Components

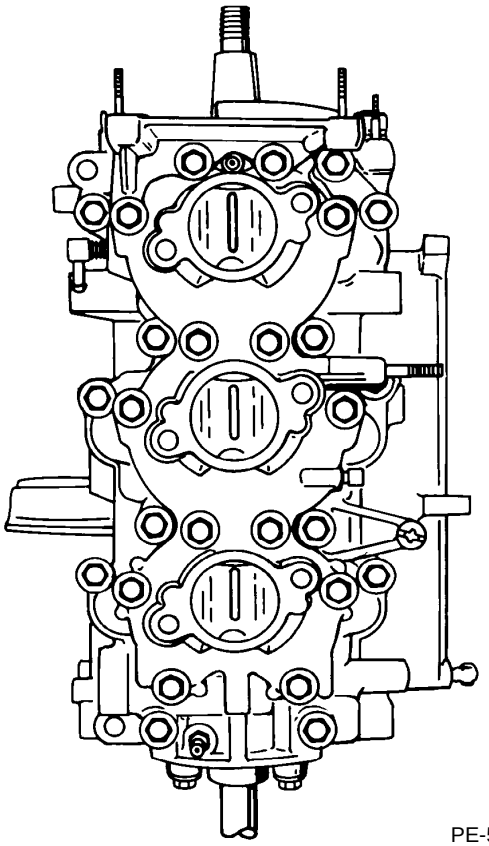
Remove the following engine components:

Component/Assembly	Section
Starter Motor	2B
Ignition Switch Box	2A*
Ignition Coil	2A*
Starter Solenoid	2B*
Voltage Regulator/Rectifier	2B*
Flywheel	2A
Stator Assembly	2A*
Trigger Assembly	2A*
Air Attenuator	3A
Carburetor and Linkage	3A
Fuel Pump	3B
Fuel Enrichment valve	3C
Shift Cable Latch Assembly	7A
Control Cable Anchor Bracket	7A
Warning Module	3D*
Oil Pump	3D

*NOTE: all ignition and electrical components can be removed and installed as an assembly.

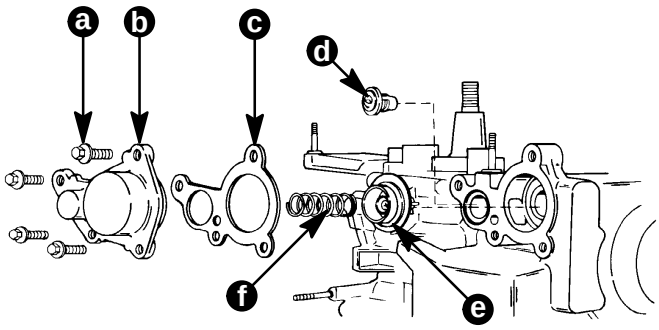
1. Place powerhead in repair stand or on bench.

NOTE: *Powerhead stand p/n 91-25821A1 can be used.*



PE-51227a

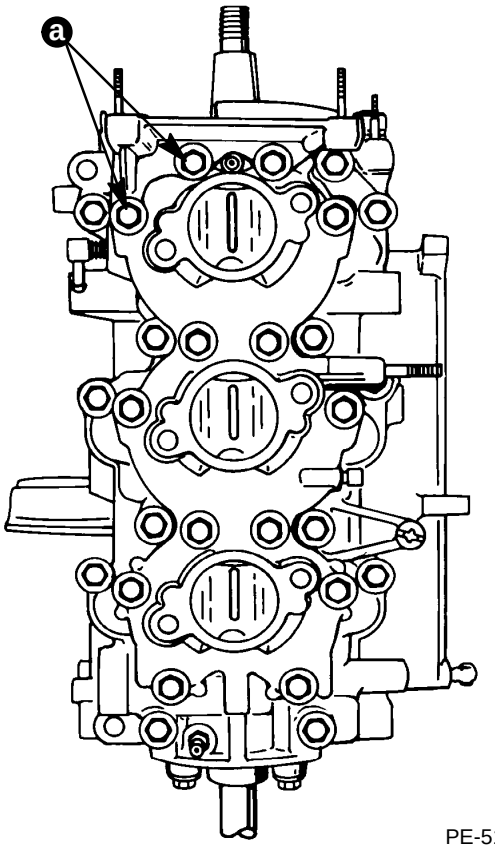
2. Remove thermostat components.



PE-51087

a - Bolts
b - Thermostat Cover
c - Thermostat Gasket
d - Thermostat
e - Poppet Valve
f - Spring

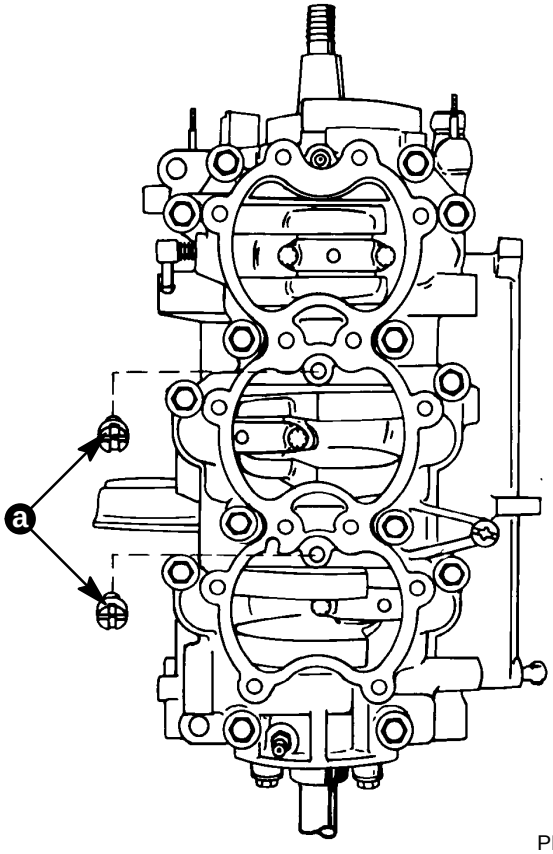
3. Remove intake manifold and reed block manifold.



PE-51227a

a - Bolts (14)

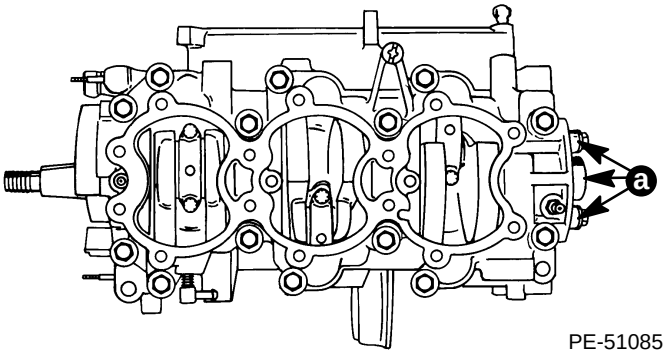
4. Remove check valves and holders.



PE-51227c

a - Check Valve/Holders

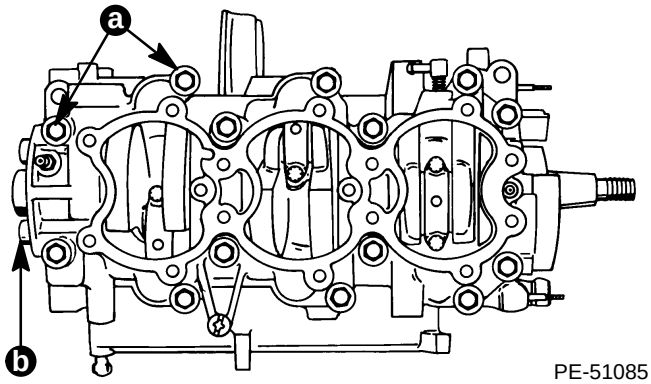
5. Place engine on work bench and remove end cap bolts.



PE-51085

a - Bolts

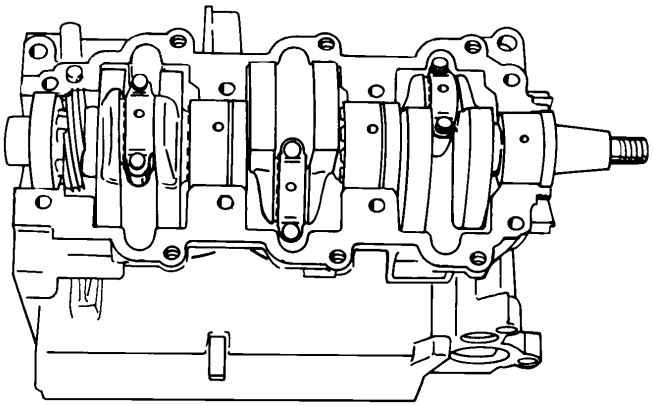
6. Remove crankcase cover bolts.



PE-51085

a - Bolts (14)
b - Lower End Cap

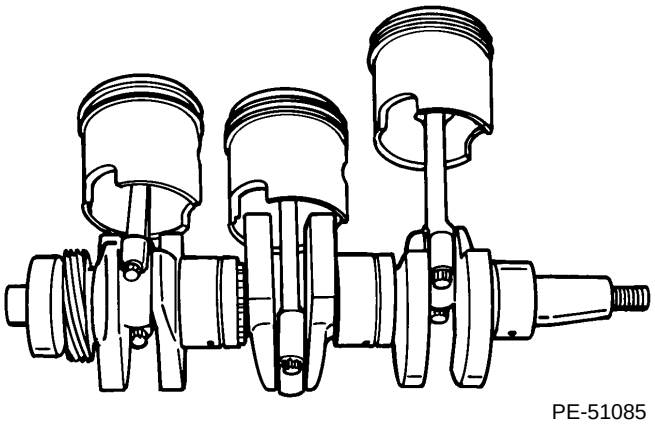
7. Remove crankcase cover from cylinder block.
8. Remove end cap.



PE-51087

Crankcase Cover Removed

9. Remove crankshaft assembly.

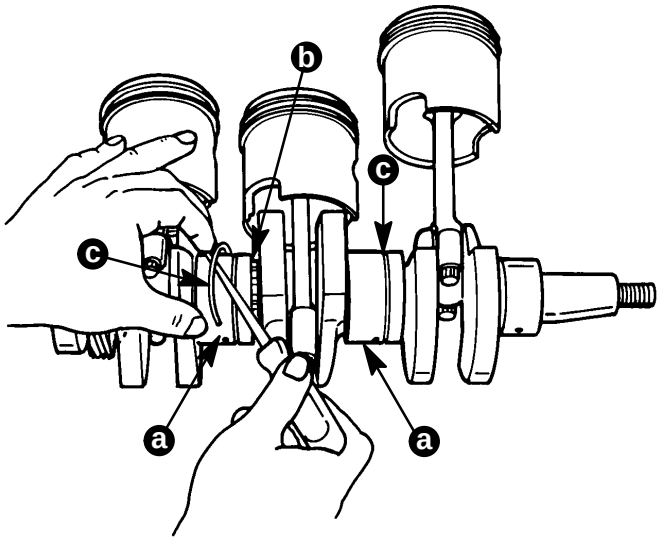


PE-51085

Crankshaft Assembly Removed

Crankshaft Disassembly

1. Remove roller bearing assemblies from crankshaft.

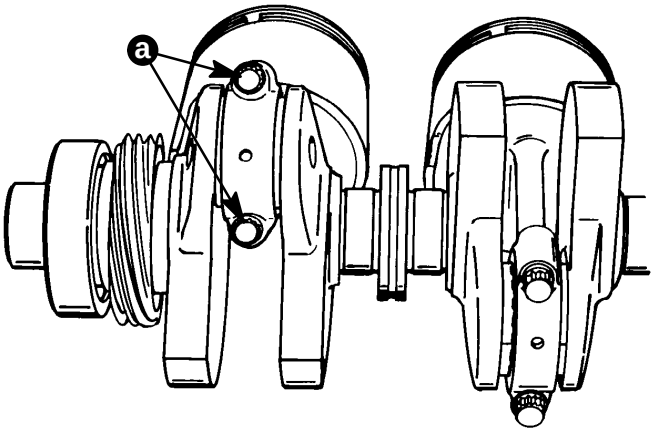


PE-51085

a - Roller Bearing Race
b - Roller Bearing
c - Retaining Ring

2. Remove 2 bolts from each rod cap. Keep components with respective connecting rod.

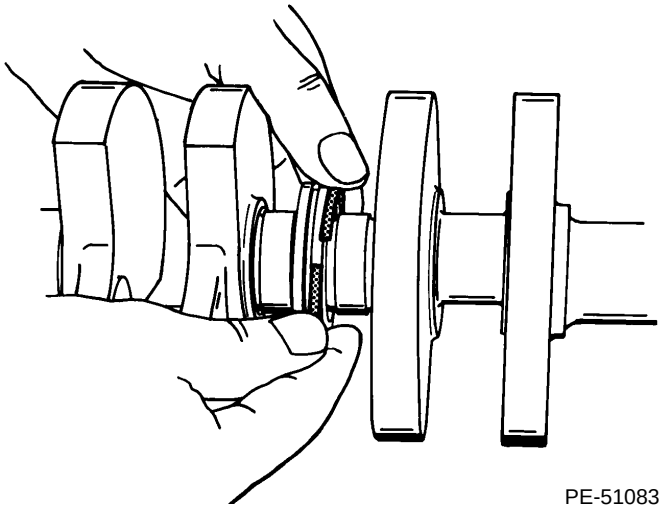
IMPORTANT: DO NOT reuse connecting rod bolts.



PE-51080

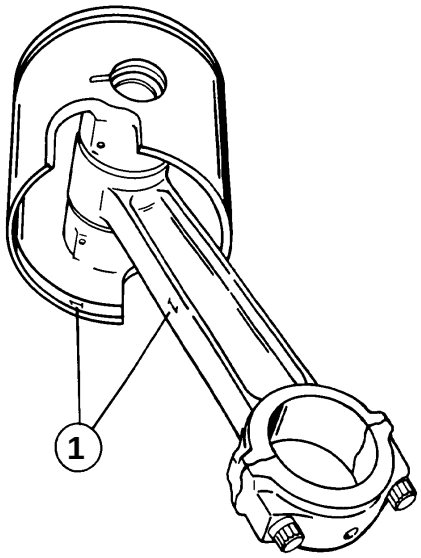
a - Bolts, use 5/16 in. – 12 point socket **or** 1/4 – 12 point socket

3. Remove connecting rod/piston assembly from crankshaft; re-attach caps to respective rod as each is removed. **CAPS MUST BE INSTALLED IN SAME DIRECTION ON SAME ROD,** or mating surface will not seat properly.
4. Remove main bearing sealing rings.



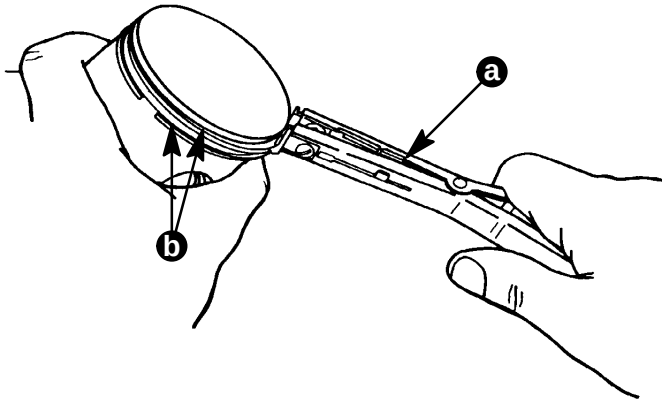
PE-51083

5. Scribe (with awl) identification number (cylinder 1, 2, and 3) on inside of piston and connecting rod in order to reassemble piston to same connecting rod.



PE-51081

6. Remove piston rings. Always install new piston rings.



PE-51081

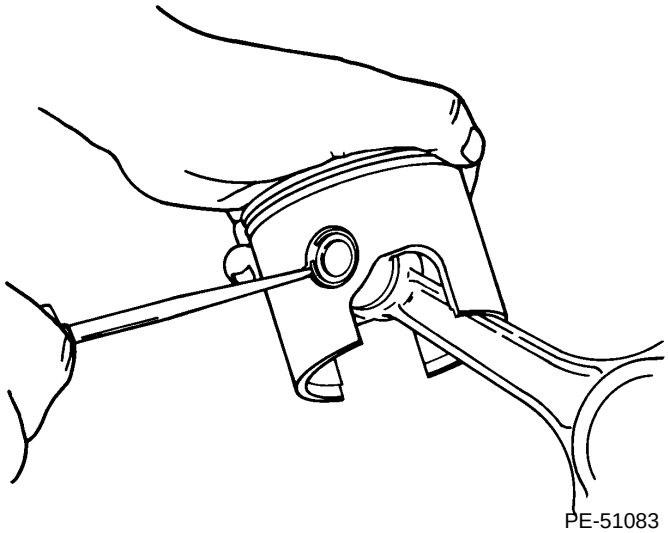
a - Piston Ring Expander (p/n 91-24697)
b - Piston Rings

NOTE: *Cylinders must be honed for rings to seat properly.*

⚠ CAUTION

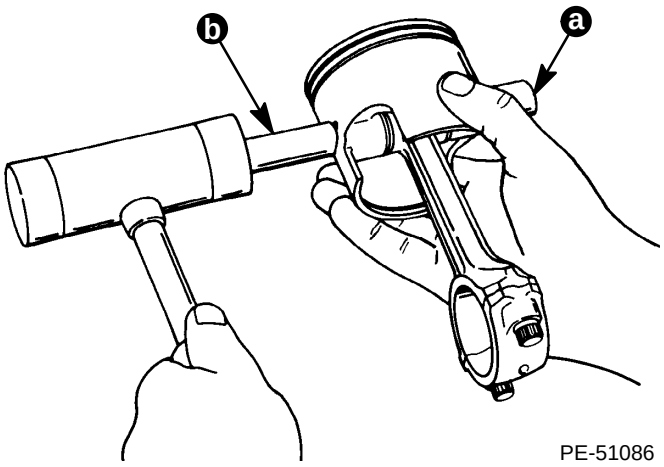
Safety glasses should be worn when removing or installing locking rings.

7. Remove piston pin lock rings using awl. Always install new lock rings.



PE-51083

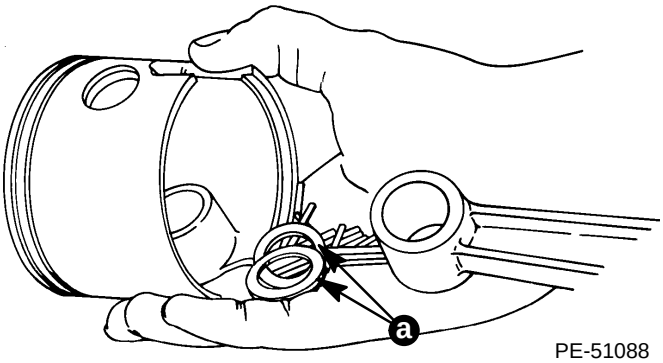
8. Remove piston pin.



PE-51086

a - Piston Pin
b - Piston Pin Tool (91-74607A2)

9. Remove piston pin needle bearings (29 per piston pin) and locating washers (“a” 2 per piston) as shown.



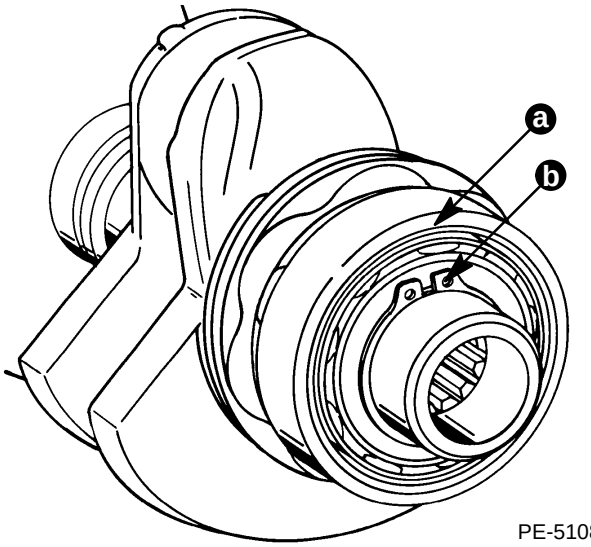
PE-51088

a - Locating Washers

⚠ CAUTION

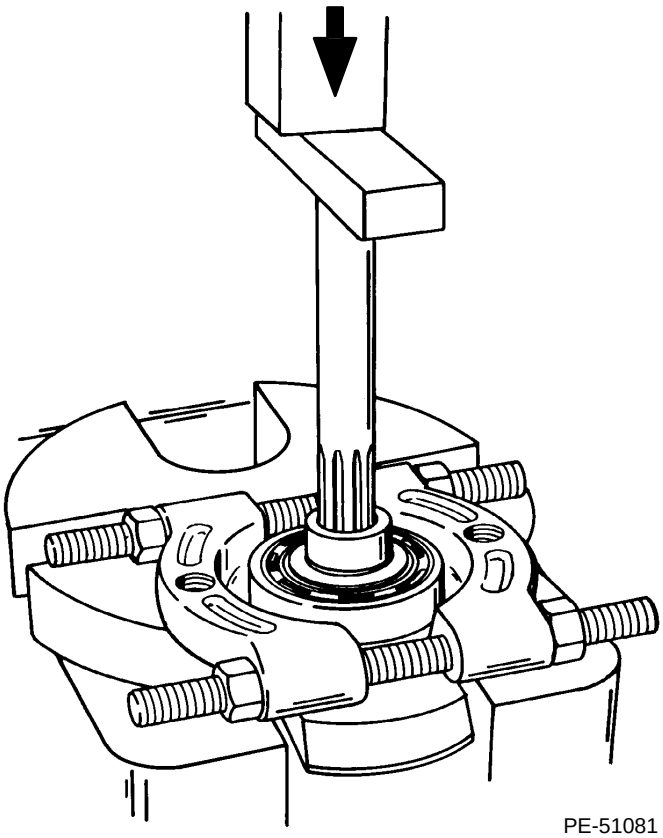
Bearing removal will cause bearing damage and will require replacement.

10. Inspect crankshaft bearing. Remove bearing (a) and retaining ring (b) only if necessary.



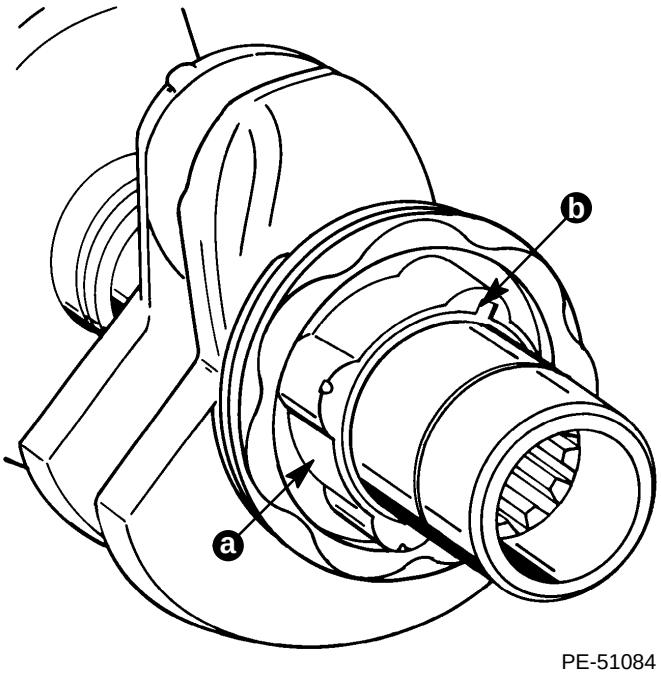
PE-51084

11. Press crankshaft bearing as shown.



PE-51081

12. Remove oil drive gear if necessary.



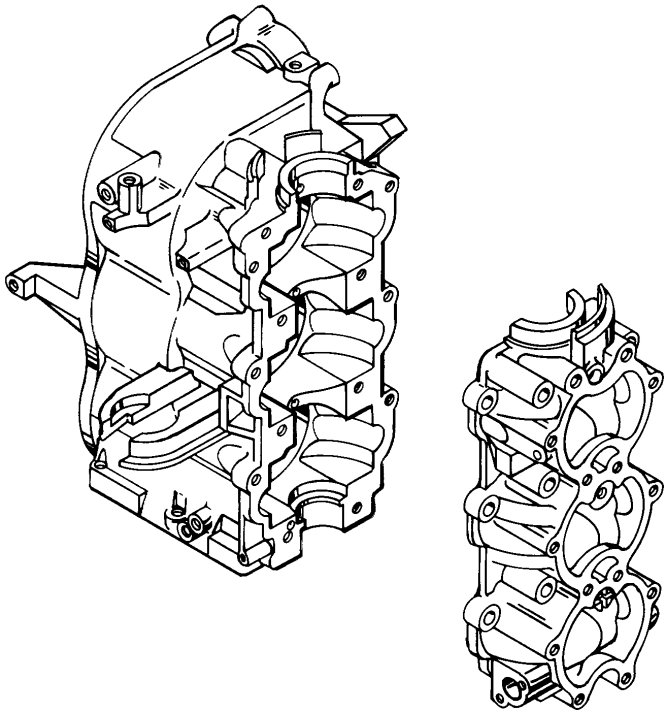
PE-51084

a - Oil Drive Gear
b - Key

Cleaning and Inspection

Cylinder Block and Crankcase Cover

IMPORTANT: Crankcase cover and cylinder block are matched, line-bored assembly should not be mismatched by using a different crankcase cover or cylinder block.



PE-51090

- Inspect cylinder block and crankcase cover for cracks or fractures.
- Check gasket surfaces for nicks, deep grooves, cracks and distortions that could cause compression leakages.
- Check that all water passages in cylinder block are not obstructed. Check locating pins in cylinder block that they are tight.
- Check crankcase cover fuel/bleed passages that they are not obstructed. Verify that check valves in crankcase cover are not damaged.
- Thoroughly clean cylinder block and crankcase cover. Verify that all sealant and old gaskets are removed from matching surfaces. Clean all carbon deposits from exhaust ports.
- Inspect spark plug holes for stripped or damaged threads.

⚠ CAUTION

If crankcase cover and cylinder block is to be submerged in a very strong cleaning solution, it will be necessary to remove the crankcase cover/cylinder block bleed system from cover/cylinder block to prevent damage to hoses and check valves.

CYLINDER BORE SIZE	
PISTON SIZE	**CYL. BLOCK FINISH HONE**
Standard Diameter	2.955 in. 75.057 mm
.015 Oversize	2.970 in. 75.438 mm
.030 Oversize	2.985 in. 75.819 mm

- Inspect cylinder bores for scoring (a transfer of aluminum from piston to cylinder wall). Cylinder wall scoring usually can be “cleaned up” by honing or reboring.

⚠ CAUTION

When reboring cylinder block, remove hone frequently and check condition of cylinder walls. DO NOT hone any more than absolutely necessary, as hone can remove cylinder wall material rapidly.

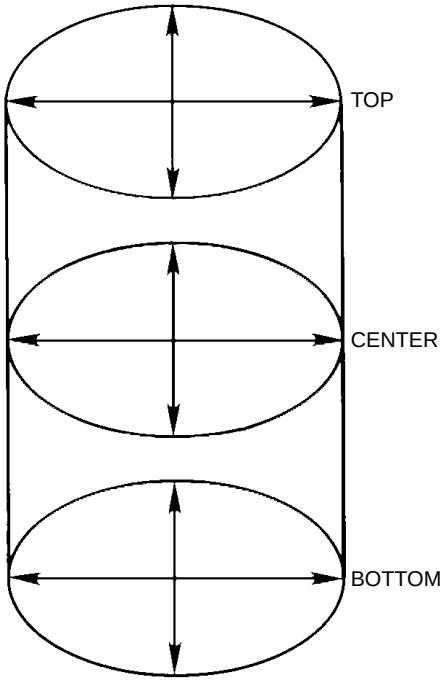
HONING PROCEDURE

Follow hone manufacture’s recommendations for use of hone cleaning and lubrication during honing.

IMPORTANT: After honing, bores should be thoroughly cleaned with hot water and detergent. Scrub well with stiff bristle brush and rinse with hot water. If any abrasive material is allowed to remain in the cylinder bore, it will cause a rapid wear of new piston rings and cylinder bore. After cleaning, bores should be swabbed several times with 2 cycle engine oil and a clean cloth. Wipe excess oil with clean, dry cloth. Cylinders should not be cleaned with kerosene or gasoline. Clean remainder of cylinder block.

- Hone all cylinder walls just enough to de-glaze.

- Measure cylinder bore inside diameter (with an inside micrometer) of each cylinder, as shown below. Check for tapered, out-of-round (“egg-shaped”) and oversize bore.



- If a cylinder bore is tapered, out-of-round or worn more than **.003 in. (0.08 mm)** from standard “Cylinder Block Finish Hone” diameter (refer to chart), it will be necessary to rebore that cylinder(s) to designated oversize bore and install oversize piston(s) and piston rings during reassembly.

NOTE: *The weight of an oversize piston is approximately the same as a standard size piston; therefore, it is not necessary to rebore all cylinders in a block just because one cylinder requires reboring.*

IMPORTANT: Ports must be deburred after honing.

- After honing and thoroughly cleaning cylinder bores, apply 2 cycle outboard oil to cylinder walls to prevent rusting.

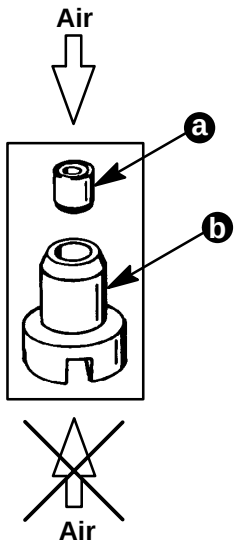
Check Valves

NOTE: *Check valves can be replaced by removing intake manifold when powerhead is attached to driveshaft housing.*

The check valves are a 3/16 in. (4.76 mm) diameter brass casing containing a nylon ball-valve. These can be damaged by hot combustion blow-by into crankcase (ie.: backfire, or a hole in top of piston, etc.).

TO CHECK: Inspect check valves by looking through hole. If light can be seen the nylon ball is bad (probably melted); REPLACE valve. If you see no light, insert fine wire into check valve hole to see if there is slight movement of nylon ball. If ball moves, valve is O.K.. Replace valve if ball does not move.

Install check valve into check valve holder as shown.



PE-51080

a - Check Valve
b - Holder

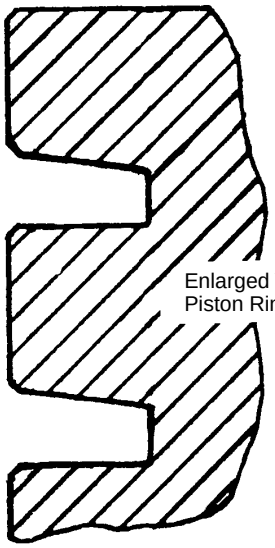
Piston and Piston Rings

IMPORTANT: If engine was submerged while engine was running, piston pin and connecting rod may be bent. If piston pin is bent, piston must be replaced. Piston pins are not sold separately because of matched fit into piston. If piston pin is bent, connecting rod must be checked for straightness (refer to “Connecting Rods” for checking straightness).

- Inspect piston for scoring and excessive piston skirt wear.
- Check tightness of piston ring locating pins. Locating pins must be tight.
- Thoroughly clean pistons. Carefully remove carbon deposits, with a soft wire brush or carbon remover solution. DO NOT burr or round off machined edges.
- Inspect piston grooves for wear and carbon accumulation. If necessary, scrape carbon from piston ring grooves being careful not to scratch sides of grooves. Refer to procedure for cleaning piston ring grooves.

CLEANING PISTON RING GROOVES

IMPORTANT: The piston rings are half – keystone rings – (tapered on the top side) – follow cleaning and inspection carefully! Chromed ring is installed on top.



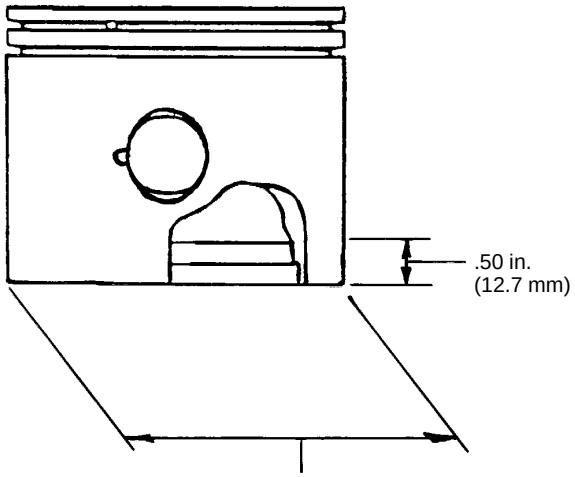
⚠CAUTION

Care must be taken not to scratch the side surfaces of ring groove. Scratching the side surfaces of the ring groove will cause damage to the ring groove.

- Use a bristle brush and carbon remover solution to remove carbon from side surfaces.
- A tool can be made for cleaning the inner diameter of the tapered ring grooves. The tool can be made from a broken tapered piston ring with the side taper removed to enable inside edge of the ring to reach the inside diameter of the groove. Carefully scrape the carbon from inner diameter of ring grooves. Care must be taken not to damage the grooves by scratching the surfaces of the grooves.

MEASURING PISTON SKIRT

Measure piston skirt at right angle (90°) to piston pin centerline, 0.50 in. (12.7 mm) up from bottom edge of skirt.



PISTON SIZE	PISTON SKIRT DIAMETER	CYL. BORE FINISH HONE
Standard Piston	2.950 in. (74.93 mm)	2.955 in. (75.057 mm)
.015 Oversize	2.965 in. (75.31 mm)	2.970 in. (75.438 mm)
.030 Oversize	2.980 in. (75.69 mm)	2.985 in. (75.819 mm)

Crankshaft

- Inspect crankshaft to drive shaft splines for wear. (Replace crankshaft, if necessary.)
- Check crankshaft for straightness. (Replace as necessary.)
- Inspect crankshaft oil seal surfaces. Sealing surfaces must not be grooved, pitted or scratched. (Replace as necessary.)
- Check all crankshaft bearing surfaces for rust, water marks, chatter marks, uneven wear and/or overheating. (Refer to “Connecting Rods”.)
- If necessary, clean crankshaft surfaces with crocus cloth as shown.



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- Thoroughly clean (with solvent) and dry crankshaft and crankshaft ball bearings. Recheck surfaces of crankshaft. Replace crankshaft if surfaces cannot be properly "cleaned up". If crankshaft will be reused, lubricate surfaces of crankshaft with light oil to prevent rust. DO NOT lubricate crankshaft ball bearings at this time.

⚠ WARNING

DO NOT spin-dry crankshaft ball bearing with compressed air.

Connecting Rods

If necessary, clean connecting rod surfaces as follows:

- Attach end caps to connecting rods. Following these directions, tighten rod cap attaching bolts to specifications. Recheck alignment.

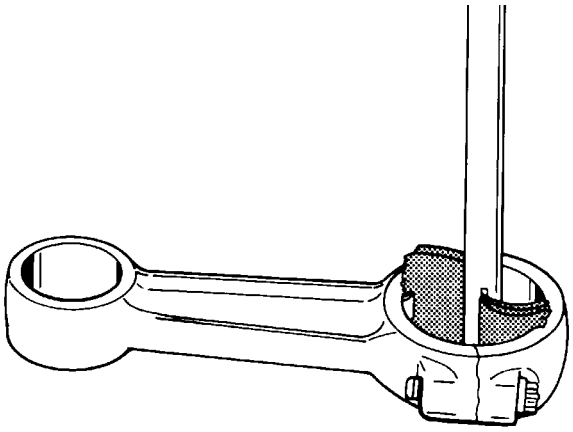
⚠ CAUTION

Crocus cloth MUST BE USED to clean bearing surface at crankshaft end of connecting rod. DO NOT use any other type of abrasive cloth.

- Clean crankshaft end of connecting rod by using crocus cloth placed in a slotted 3/8 in. (9.5 mm) diameter shaft, as shown. Insert shaft in a drill press and operate press at full speed while keeping connecting rod at a 90° angle to slotted shaft.

IMPORTANT: Clean connecting rod just enough to clean bearing surfaces. DO NOT continue to clean after marks are removed from bearing surfaces.

- Clean piston pin end of connecting rod, using same method as above. Use 320 grit carborundum cloth instead of crocus cloth.
- Thoroughly wash connecting rods to remove abrasive grit. Recheck bearing surfaces of connecting rods. Replace any connecting rod that cannot be properly polished. Lubricate bearing surfaces of connecting rods which will be reused with 2 cycle engine oil to prevent rust.

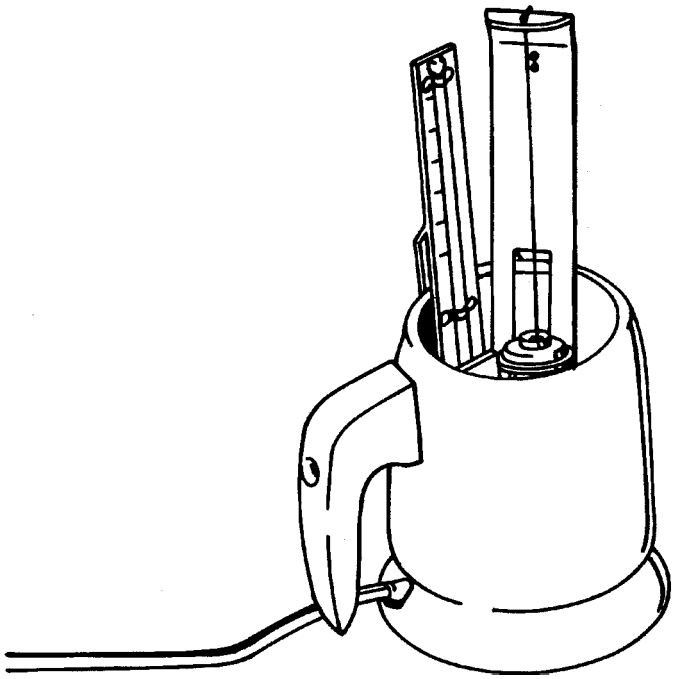


-51083

Thermostat

Wash thermostat with clean water. Using a thermostat tester, similar to the one shown, test thermostat as follows:

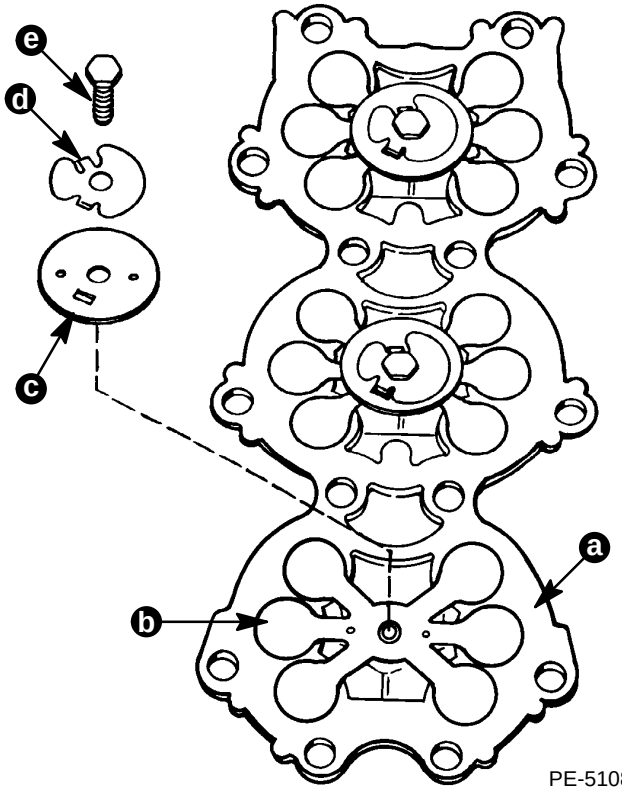
- Open thermostat valve, then insert a thread between valve and thermostat body. Allow valve to close against thread.
- Suspend thermostat (from thread) and thermometer inside tester so that neither touches the container. Bottom of thermometer must be even with bottom of thermostat to obtain correct thermostat opening.
- Fill thermostat tester with water to cover thermostat.
- Plug tester into electrical outlet.
- Observe temperature at which thermostat begins to open. Thermostat will drop off thread when it starts to open. Thermostat must begin to open when temperature reaches 5 °F (3 °C) above designated stamping on bottom of thermostat.
- Continue to heat water until thermostat is completely open.
- Unplug tester unit.
- Replace thermostat, if it fails to open at the specified temperature, or if it does not fully open.



PE-51087

Reed Blocks

NOTE: *Do not disassemble reed block unless necessary.*



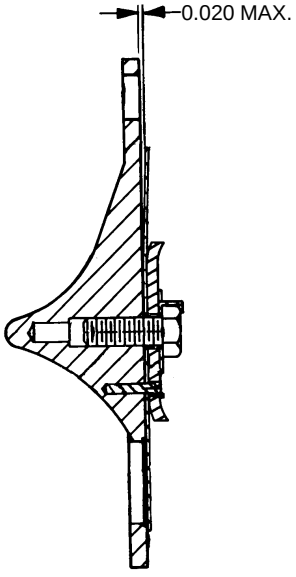
PE-51089

a - Reed Block
b - Reed (3 Sets)
c - Retaining Washer
d - Tab Washer
e - Bolt (With Loctite Grade “A”)

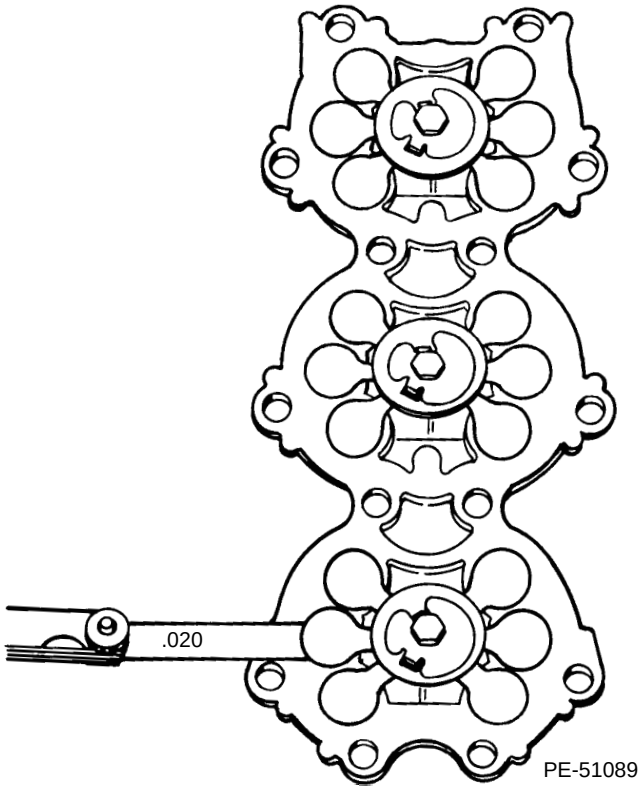
IMPORTANT: Do not “flop” (reverse) the reed petels for additional use – replace reed when necessary.

Reed should lie flat. There should be no pre-load (pressure between reed and reed-block), although a slight pre-load is tolerable.

The maximum allowable opening between reed and reed-block is 0.020 in. (0.5mm). This must be checked with a flat blade feeler gauge, as shown.



If the opening exceeds .020 in. (0.5 mm), or if the reed is chipped, cracked or otherwise damaged, replace.

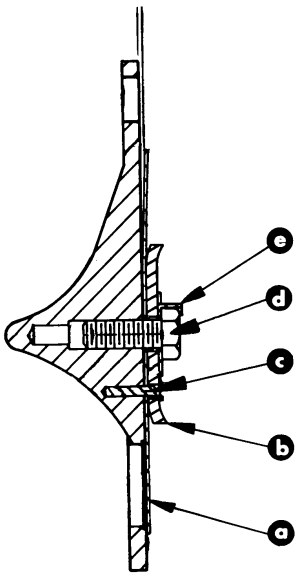


PE-51089

⚠ CAUTION

Replace locking tab-Washer. DO NOT REUSE.

If reed block was disassembled, reassemble by locating reeds (a) on pins with (c) retaining washer (b). Use new tab-washer. Insert bolt (d), and torque to 60 lb. in. (6.5 N·m); then, if necessary, continue the torque to align flat on hex-head to locking tab (e). DO NOT exceed 100 lb. in. (11.5 N·m) of torque. Bend up lock tab to secure bolt position.



Powerhead Reassembly and Installation

General Information

Before proceeding with powerhead reassembly, be sure that all parts to be reused have been carefully cleaned and thoroughly inspected, as outlined in “Cleaning and Inspection”. Parts, which have not been properly cleaned (or which are questionable), can severely damage an otherwise perfectly good powerhead within a few minutes of operation. All new powerhead gaskets must be installed during assembly.

During reassembly, lubricate parts with Quicksilver 2-Cycle Outboard Oil whenever 2-cycle oil is specified, and Quicksilver 2-4-C Marine Lubricant whenever grease is specified.

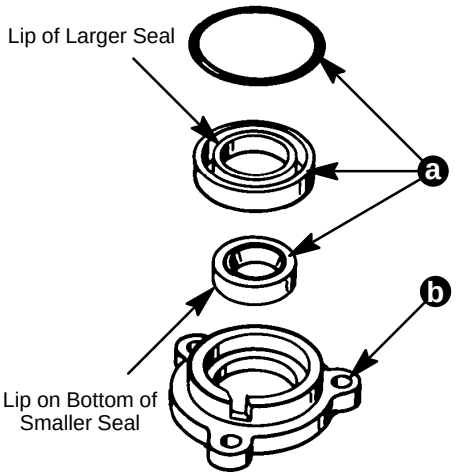
A torque wrench is essential for correct reassembly of powerhead. Do not attempt to reassemble powerhead without using a torque wrench.

End Cap

1. Clean thoroughly, including seal and O-ring seats; remove Perfect Seal residue and clean cap-to-head mating surface.
2. Using suitable mandrel, press oil seals into cap until fully seated.

NOTE: *Lip of smaller seal faces away from powerhead. Lip of larger seal faces towards powerhead.*

3. Lubricate oil seal lips with 2-cycle oil.
4. Lubricate O-ring seal with 2-cycle oil and install in groove.
5. Apply Perfect Seal to flange of end cap.



PE-51088

a - 2-Cycle Oil
b - Perfect Seal

⚠ CAUTION

Any GREASE used for bearings INSIDE the powerhead MUST BE gasoline soluble. Use only Quicksilver Needle Bearing Assembly Lubricant. DO NOT use 2-4-C Marine Lubricant, or other lubricants inside the powerhead, or damage may occur.

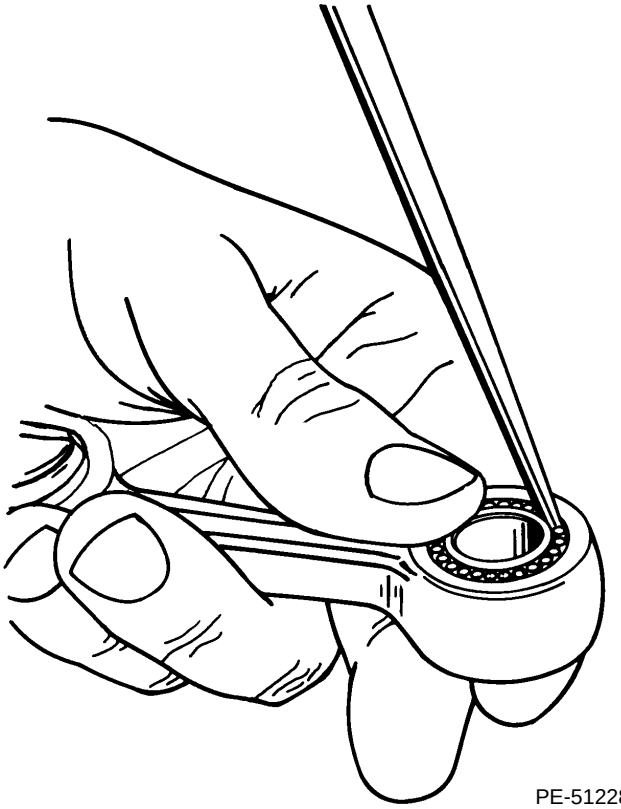
Assembling Rod to Piston

⚠ CAUTION

Never intermix new needle bearings with used needle bearings. It is required to replace needle bearings as a set. Never intermix needle bearings from one connecting rod with those of another connecting rod

1. Place clean needle bearings on a clean sheet of paper and lubricate with Quicksilver Needle Bearing Lubricant.

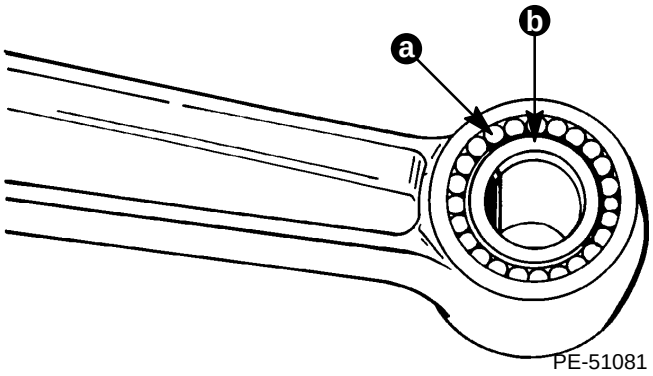
Service Tip



PE-51228

If the tip of an awl can be inserted between needle bearings, one or more needles are missing and must be replaced.

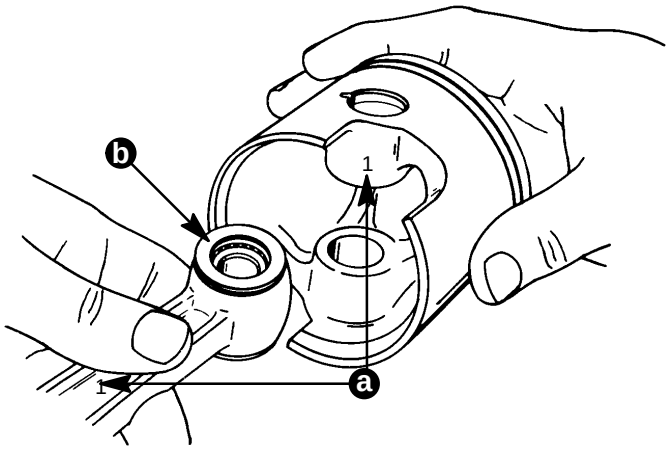
2. Install needle bearings.



PE-51081

a - Needle Bearings (29)
b - Sleeve [from Piston Pin Tool (91-74607A2)]

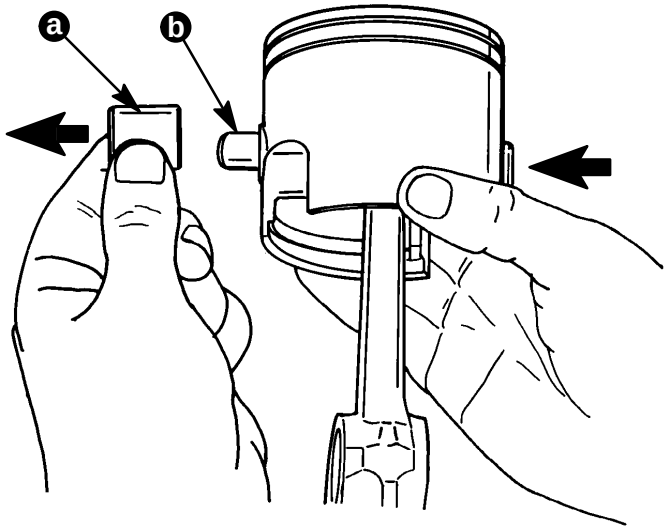
3. Place locating rings on connecting rod, carefully place piston over end of rod. Refer to scribed identification number for matching rod to piston and direction of assembly (which side of rod is “UP”).



PE-51083

a - Scribed Identification Number
b - Locating Washer

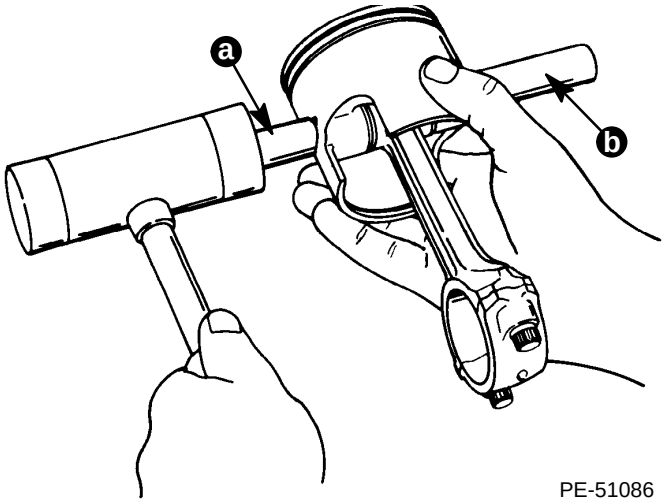
4. Push sleeve from piston using piston pin tool.



PE-51080

a - Sleeve
b - Piston Pin Tool (91-74607A2)

5. Place piston pin over tool, and tap into position (driving tool out other side).



PE-51086

a - Piston Pin
b - Piston Pin Tool

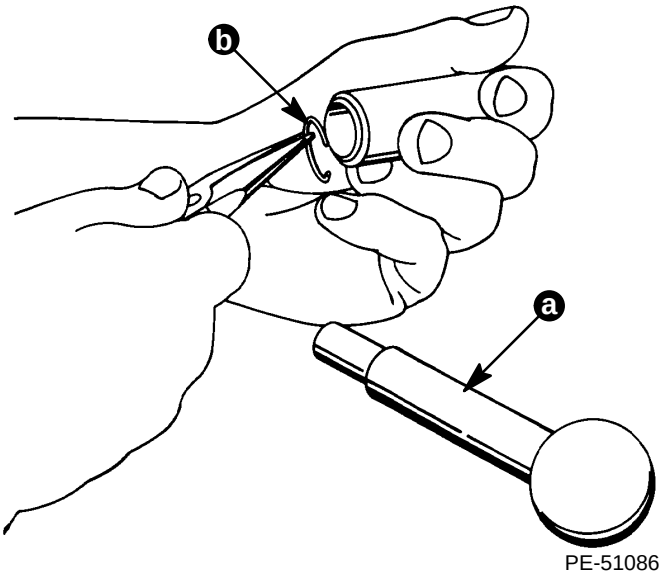
⚠ WARNING

Eye protection must be worn while installing piston pin lockrings.

6. Install new piston pin lockrings (each side of piston) using Lockring Tool (p/n 91-77109A1).
7. Make sure lockrings are properly seated in piston grooves.

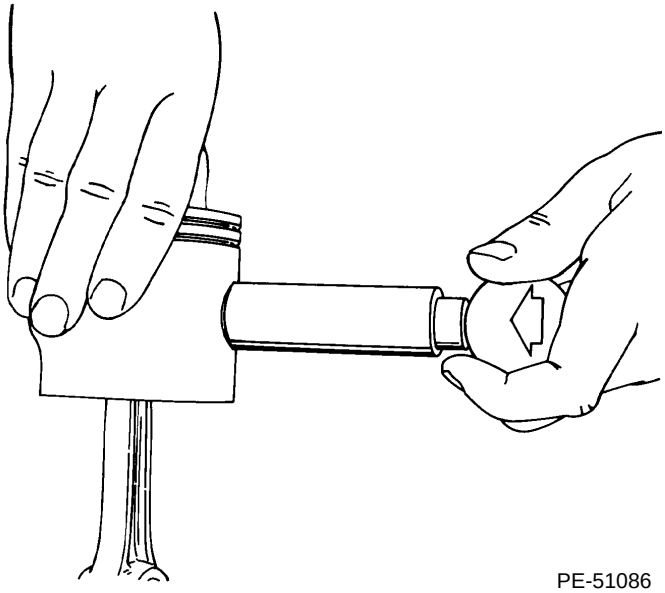
⚠ CAUTION

Do not re-use piston pin lockrings. Use only new lockrings and make sure they are properly seated in piston grooves.



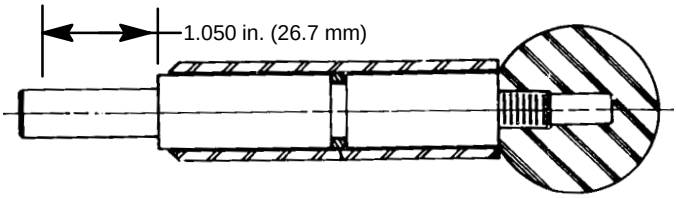
PE-51086

a - Lockring Installation Tool (91-77109A1)
b - Lockring (2)



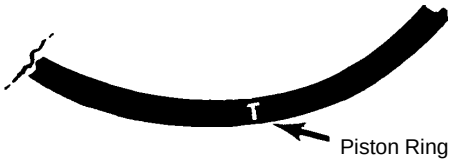
PE-51086

NOTE: *Shaft of Lockring Installation Tool 91-77109A1 must be modified (shortened) to 1.050 in. (26.7 mm).*

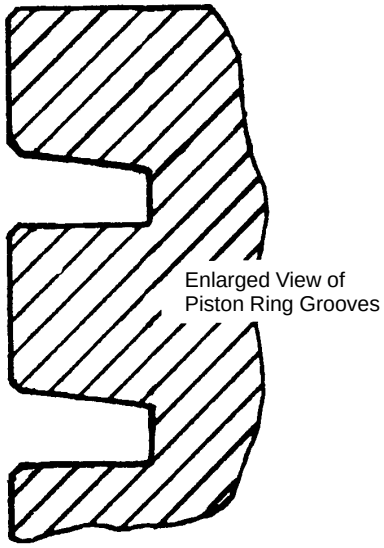


Piston Ring Installation

IMPORTANT: Piston ring side with letter or mark must be facing up.



Piston rings are TAPERED top side, and flat (rectangular) on the bottom side (half-keystone rings). Note that,top ring is chromed and bottom ring is steel.



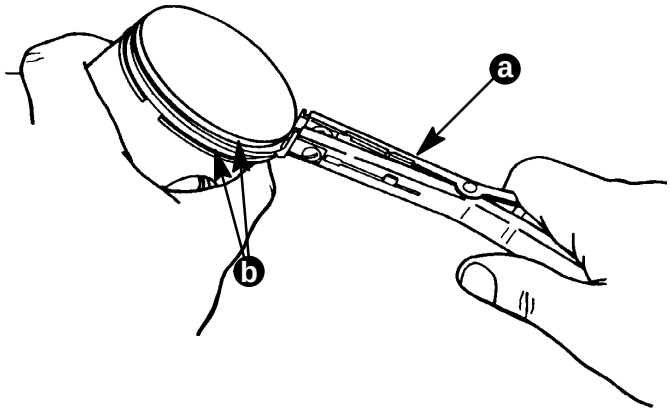
⚠ CAUTION

Care must be taken not to scratch the side surfaces of ring groove. Scratching this area will damage the ring groove.

1. Install piston ring in appropriate groove on piston using Piston Ring Expander Tool. Spread rings just enough to slip over piston.

   Top Groove – Chromed Ring
   Bottom Groove – Steel Ring

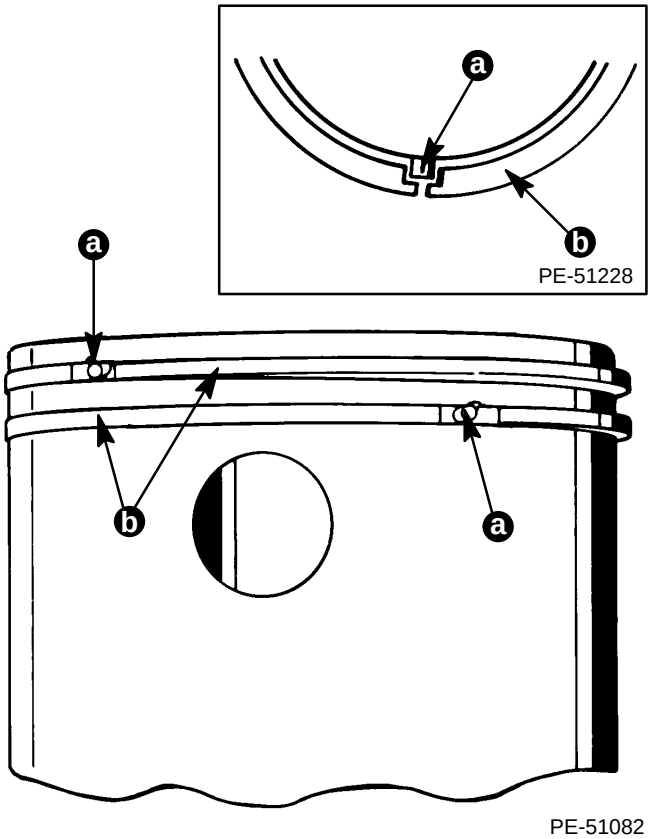
2. Check piston rings to be sure they fit freely in groove. Lubricate rings and cylinder wall with 2-cycle oil.



PE-51081

a - Piston Ring Expander
b - Piston Rings

3. Align piston ring end gaps with ring locating pins as shown. Check locating pins making sure they are tight.

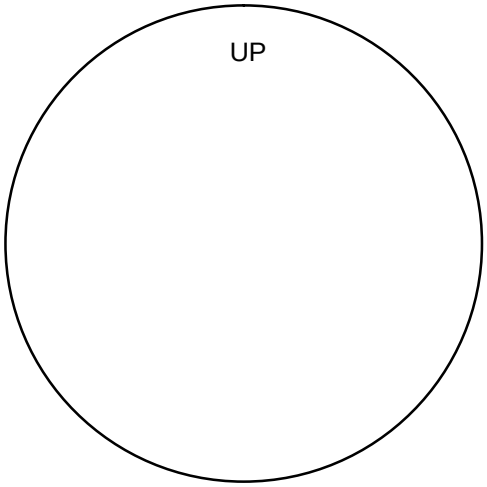


PE-51082

a - Locating Pin
b - Piston Rings

4. Remove connecting rod cap from connecting rod being installed.

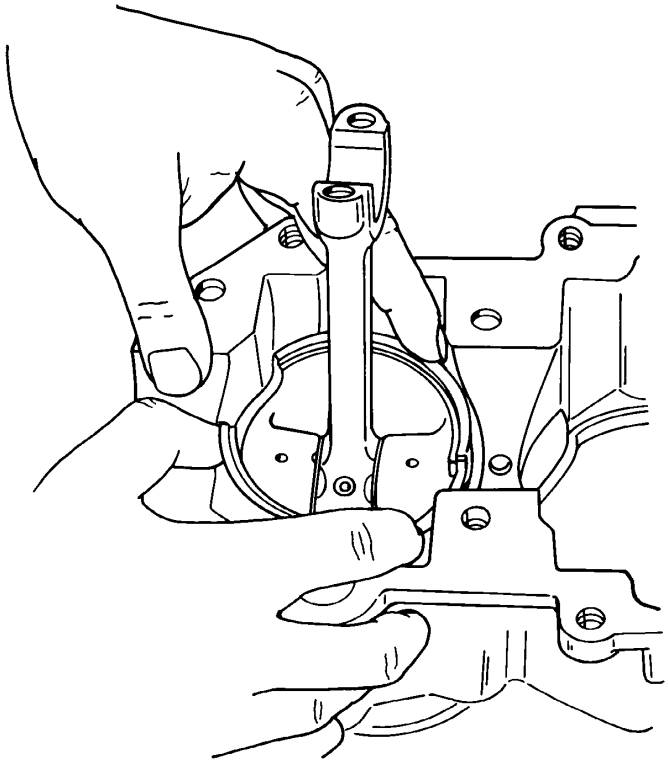
5. Install each piston with “UP” identification facing flywheel end. Pistons MUST be installed in this direction.



⚠ CAUTION

Pistons must be installed very carefully into cylinders. Piston rings can not be inspected thru exhaust ports.

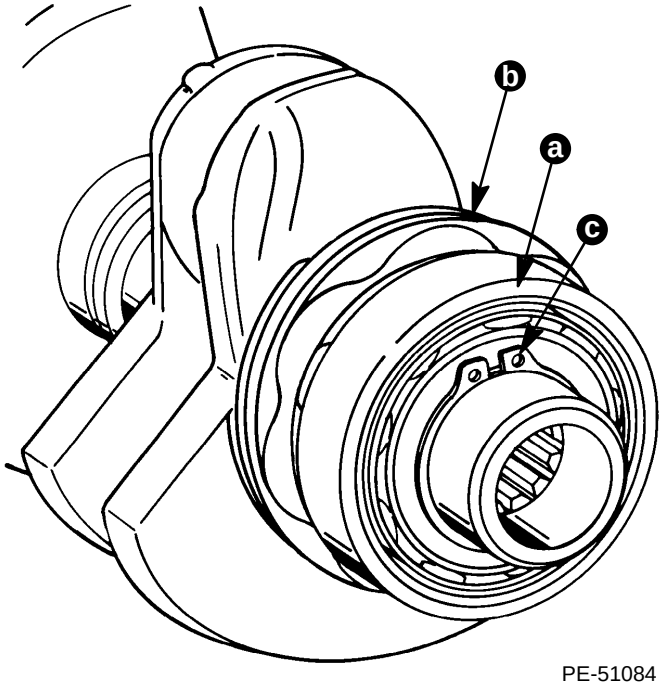
6. Bottom end of cylinder bore has taper which permits the insertion of the piston into block without using a piston ring compressor. Place piston carefully into cylinder.



PE-51087

Crankshaft Installation

1. If lower bearing and gear were removed from crankshaft, slide gear in place (note keyway and key in gear to crankshaft assembly). Install gear to crankshaft using an arbor press and suitable mandrel.
2. Install main bearing retaining ring after pressing main bearing tight against oil gear.



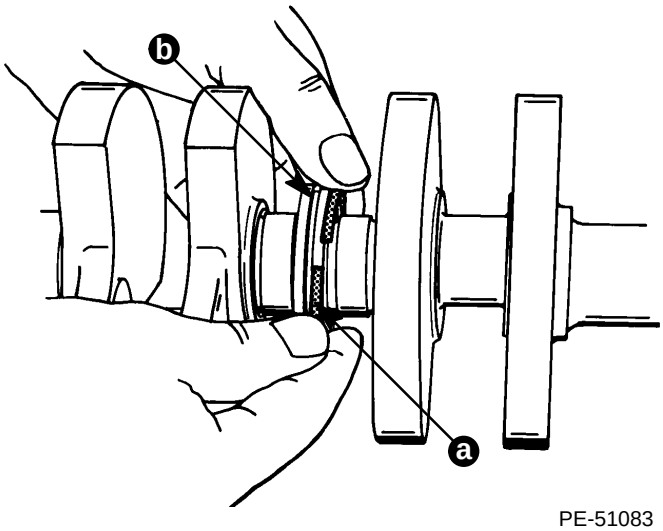
PE-51084

a - Lower Bearing
b - Gear
c - Retaining Ring

⚠ CAUTION

Safety glasses should be worn when removing or installing ring seals.

3. Install ring seals (2) to crankshaft.



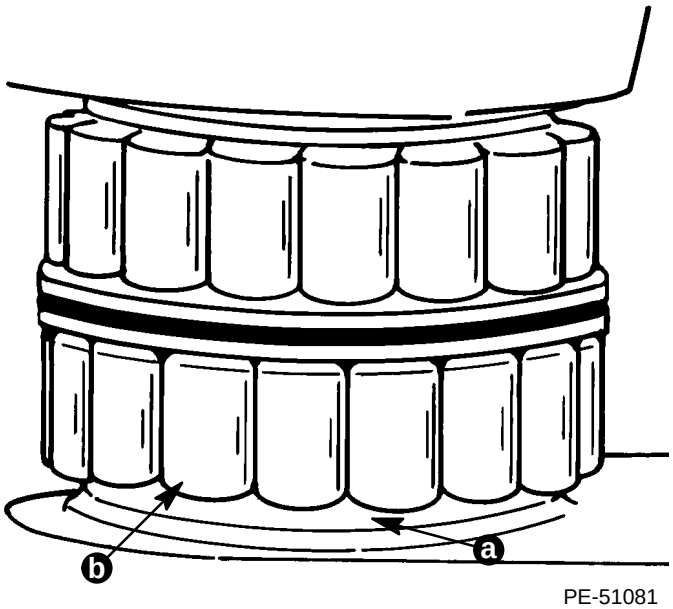
PE-51083

a - Ring Seal
b - Slot On Crankshaft

⚠ CAUTION

Any grease used for bearings INSIDE the powerhead MUST BE gasoline soluble. Use only Quicksilver Needle Bearing Assembly Lubricant. DO NOT use 2-4-C Marine Lubricant, or other lubricants inside powerhead, or damage to engine may occur.

4. Grease crankshaft journal with Quicksilver Needle Bearing Assembly Lubricant to hold bearing in place. Position needle bearings on journal. There are 28 bearings per each center main.

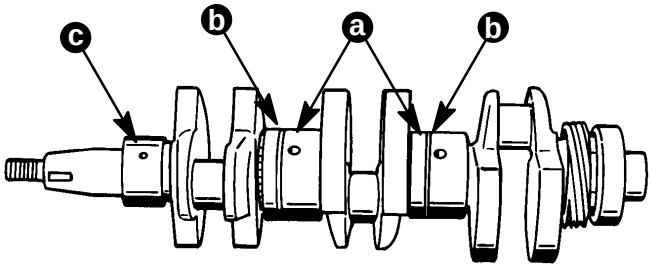


PE-51081

a - Crankshaft Journal
b - Bearings (28)

IMPORTANT: Snap ring groove faces up towards flywheel.

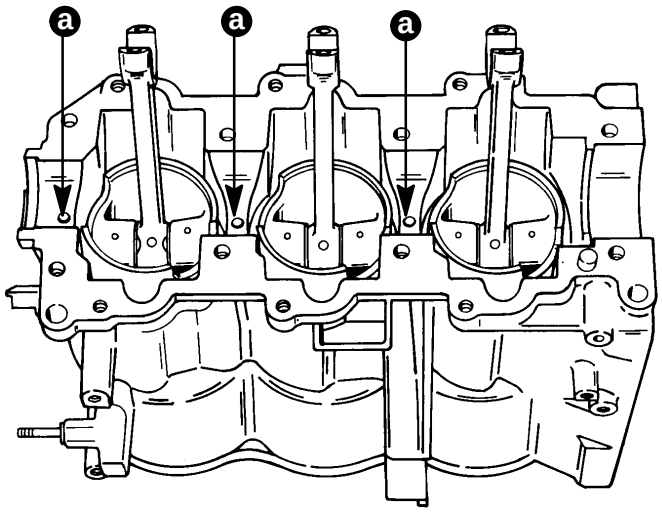
5. Attach main bearing races with holes towards lower gear end of crankshaft. Secure each main bearing race with retaining ring. Lubricate top main bearing with 2-cycle engine oil and install to crankshaft as shown.



PE-51083

a - Main Bearing Race
b - Retaining Ring **(Groove Faces Flywheel)**
c - Top Main Bearing (One Piece)

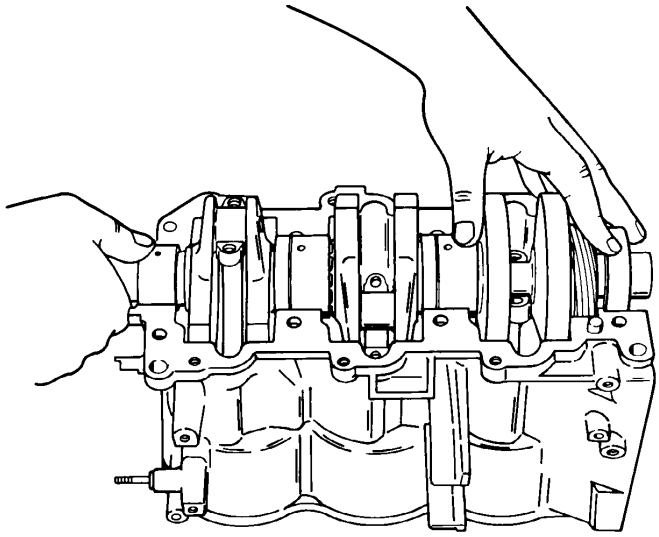
6. Position cylinder block and piston rods as shown. Insert locating pins (a).



PE-51088

Flywheel End **Lower End**

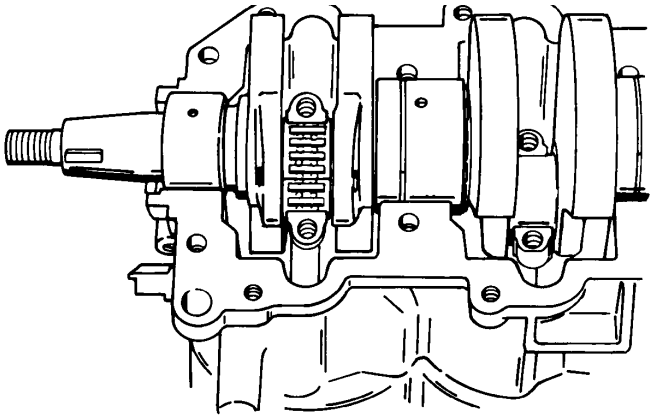
7. Place crankshaft into cylinder block; align and seat top and center main bearings so that locating pins on block align with larger holes in each bearing race.



PE-51080

Installing Rods to Crankshaft

1. Oil rod and bearing cage with 2-cycle oil.
2. Pull rod into place and install bearing cages as shown.

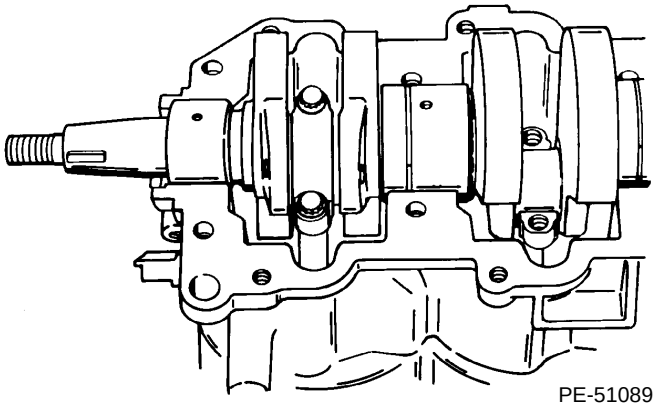


PE-51080

NOTE: *Clean rod bolt/rod cap bolt holes of oil and debris before reassembly.*

IMPORTANT: The rod cap and rod must be aligned and held together when threading oiled bolt. Check that mating surfaces are tight together after bolt enters threads in piston rod.

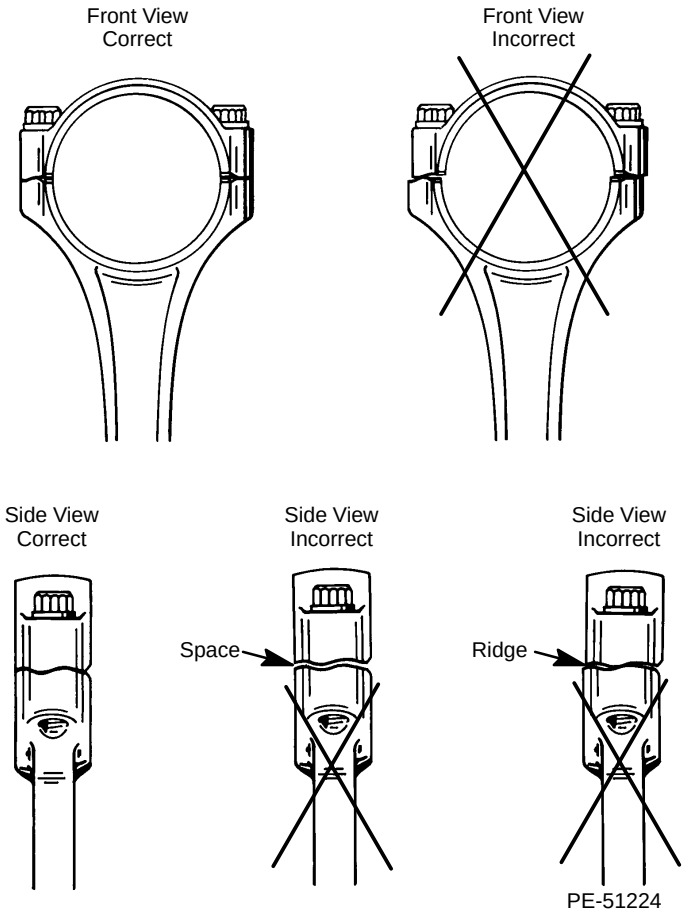
3. Place rod cap over bearing cages. While holding cap to rod, insert slightly oiled bolts and lightly tighten while observing cap to rod alignment.



PE-51089

Connecting Rod Cap Alignment

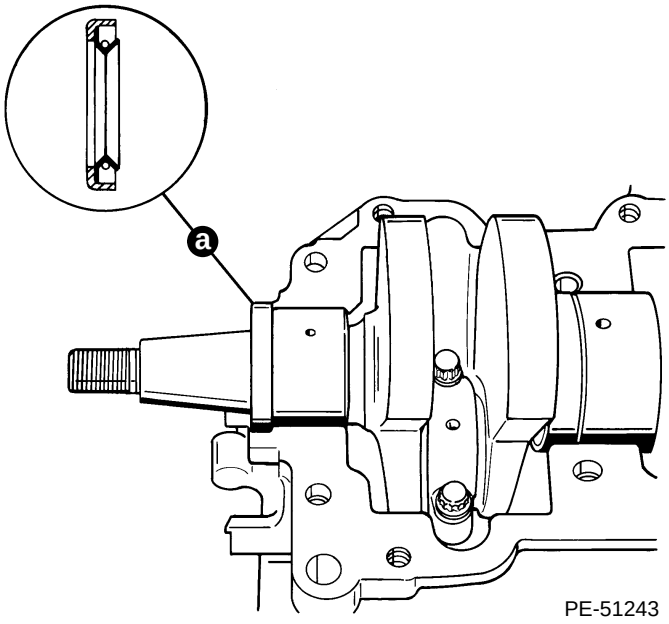
1. Check each connecting rod for correct alignment by carefully running fingernails up and down edge of rod cap. If not aligned, a ridge can be seen or felt at the separating line. Correct any misalignment.



2. When connecting rods are attached, and bolts drawn down finger tight, torque rod-cap bolts to 15 lb. in. (1.7 N·m). Recheck alignment. **Re-torque 1/4 in. bolts to 120 lb. in. (13.5 N·m) and then turn additional 1/4 turn or 5/16 in. bolts to 27 lb. ft. (36.5 N·m).** Recheck alignment.

Crankcase Cover to Block

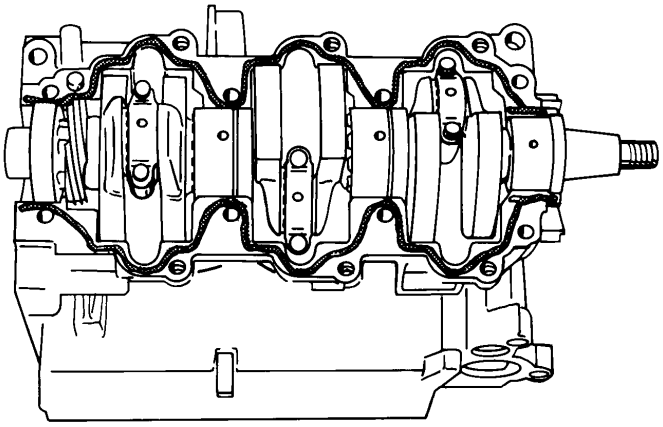
1. Install upper seal to crankshaft.



a - Oil Seal (Lubricate Inside with 2-cycle oil)

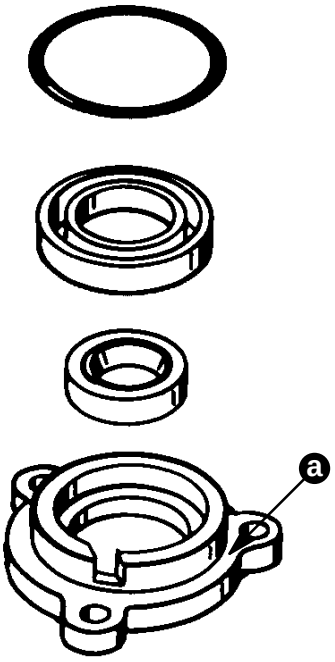
2. Apply LOCTITE MASTER GASKET SEALANT to clean block surface. Instructions in kit must be followed exactly.

IMPORTANT: Extend sealer to edge on each center main journal to prevent blow-by between cylinders.



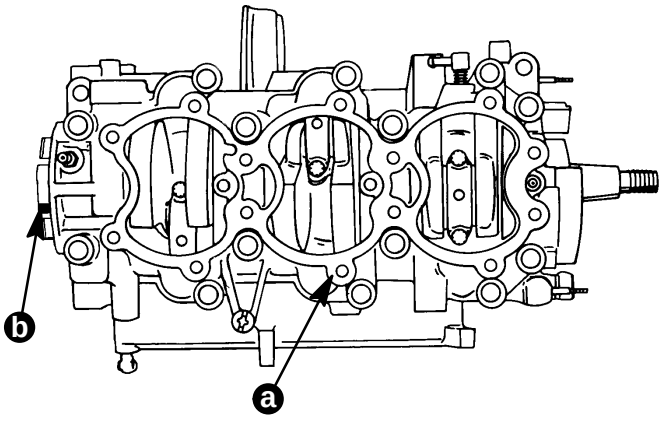
Sealant "Bead Pattern" Indicated by Bold Line Above

3. Install end cap assembly (lubricate seals with 2-cycle engine oil) to block. Apply Perfect Seal to flange of end cap (a).



PE-51088

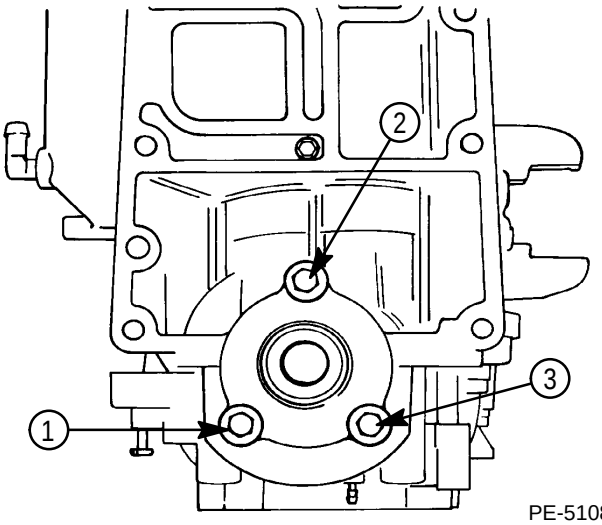
4. Place crankcase cover onto block.



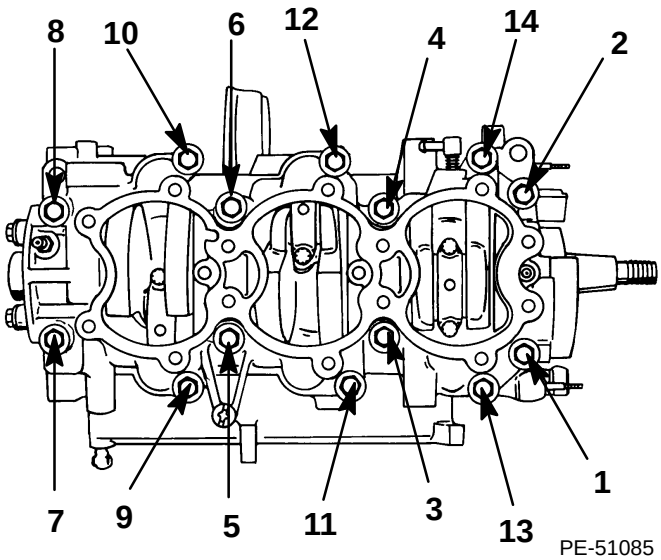
PE-51084

a - Crankcase Cover
b - End Cap

5. Insert clean bolts (note 2 sizes) and finger tighten.
6. Torque bolts to 18 lb. ft. (24.5 N·m) following sequence shown below.



PE-51086



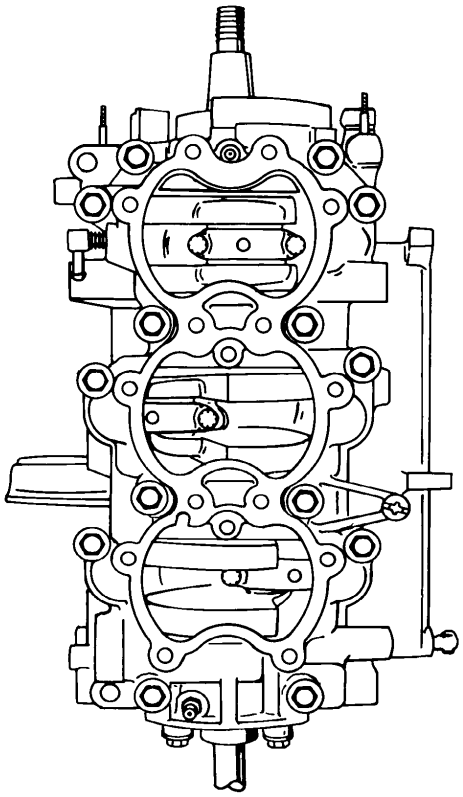
PE-51085

NOTE: *Inspect all hoses on reinstallation. Replace if necessary.*

Intake/Reed Block Manifold Installation

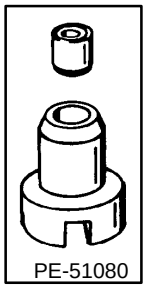
1. Place engine on repair stand or on bench.

NOTE: *Powerhead repair stand p/n 91-25821A1 can be used.*

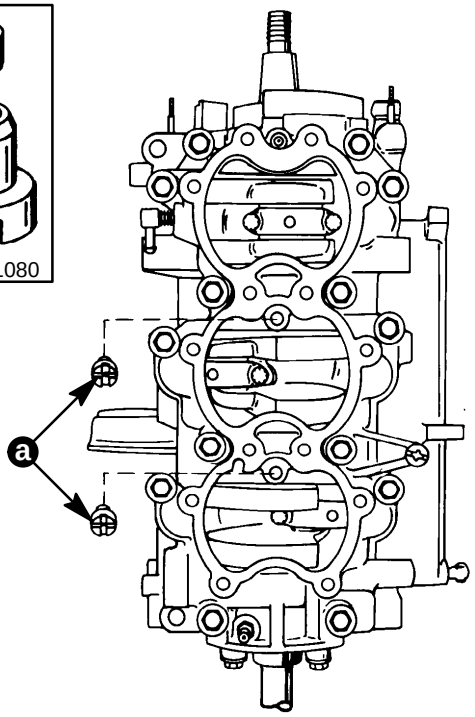


PE-51227

2. Install check valve/holders.



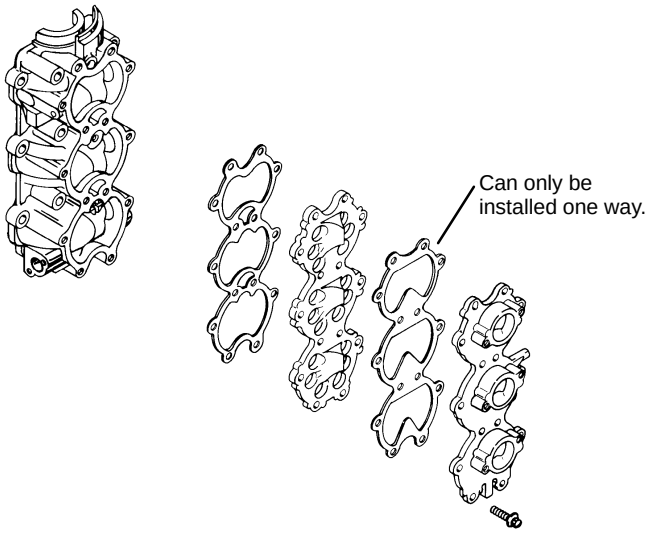
PE-51080



PE-51227

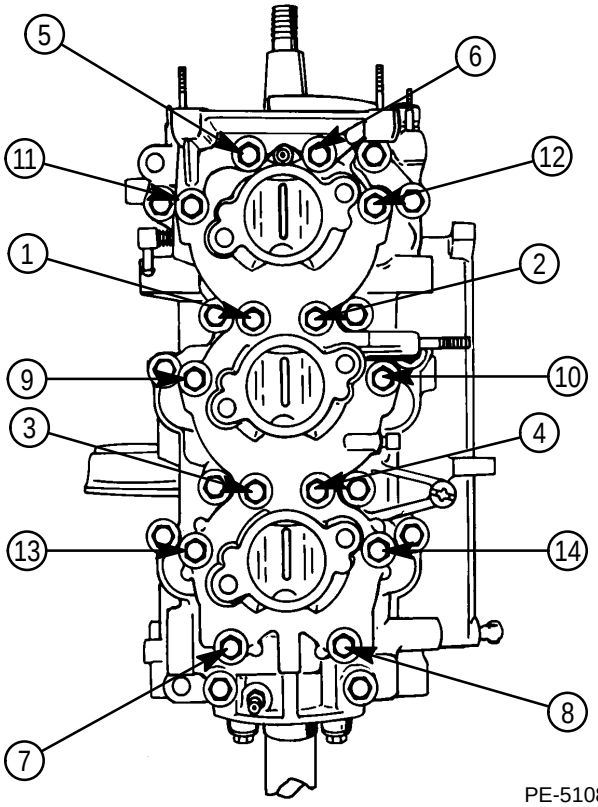
a - Check Valve/Holders

3. Install reed block manifold and intake manifold with gasket to cylinder block.



PE-51225

4. Install bolts and torque to 18 lb. ft. (24.5 N·m) in sequence shown below.

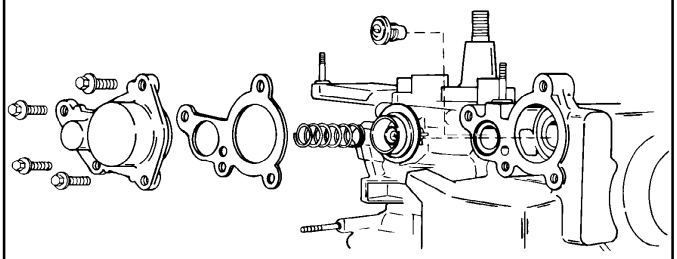


PE-51085

Thermostat Cover Installation

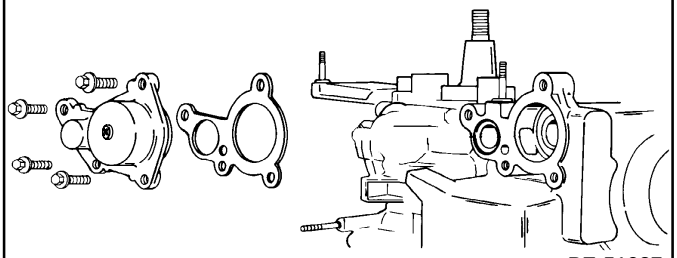
1. Install thermostat components into cylinder block. Torque bolts to 18 lb. ft. (24.5 N·m).

50/60 Models



PE-51087

55 Model



PE-51087

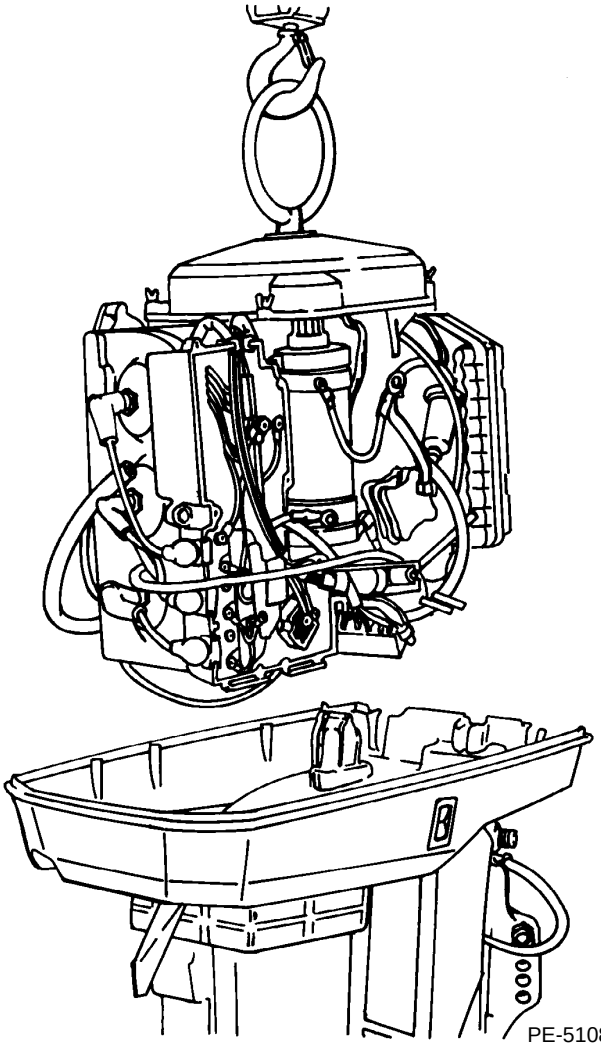
Install Remaining Engine Components

Component/Assembly	Section
Starter Motor	2B
Ignition Switch Box	2A*
Ignition Coil	2A*
Starter Solenoid	2B*
Voltage Regulator/Rectifier	2B*
Flywheel	2A
Stator Assembly	2A*
Trigger Assembly	2A*
Air Silencer	3A
Carburetor and Linkage	3A
Fuel Pump	3B
Fuel Enrichment Valve	3C
Shift Cable Latch Assembly	7A
Control Cable Anchor Bracket	7A
Warning Module	3D*
Oil Pump	3D

* Note: All ignition and electrical components can be removed and installed as an assembly.

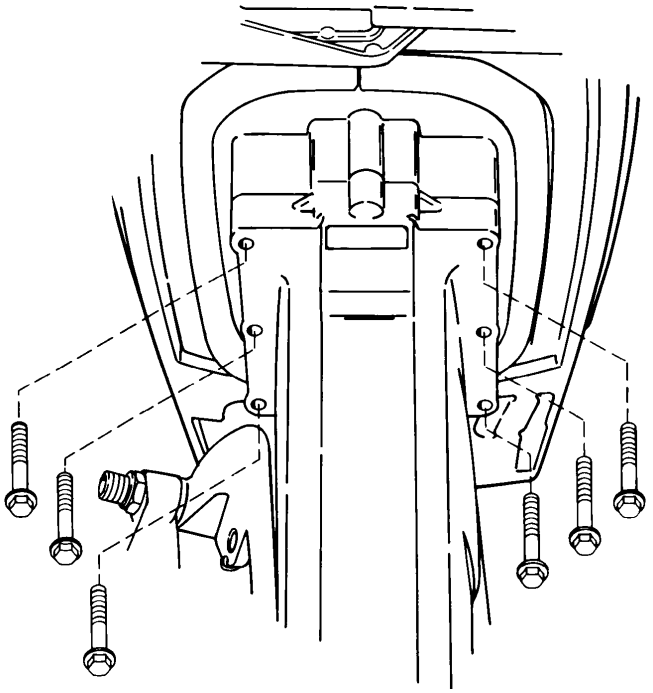
Powerhead Installation

1. Install lifting eye (p/n 91-90455) into flywheel a minimum of 5 turns. Install powerhead to driveshaft housing. Slide shift slide on rail while lowering powerhead on splines of drive shaft.



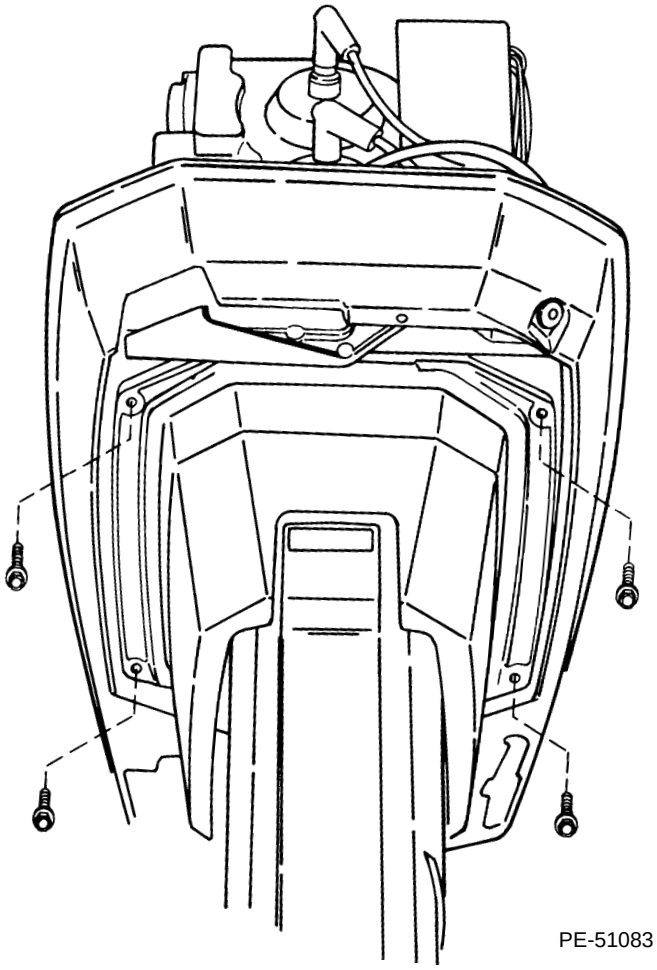
PE-51081

2. Install Powerhead bolts. Torque to 28 lb.ft. (38.0 N·m).



PE-51088

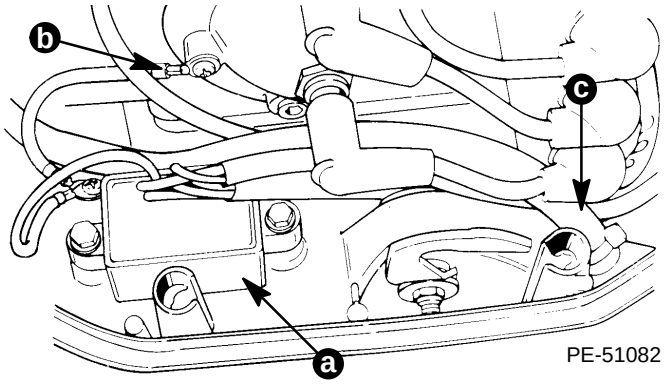
3. Install cover. Torque bolts to 80 lb. in. (9.0 N·m).



PE-51083

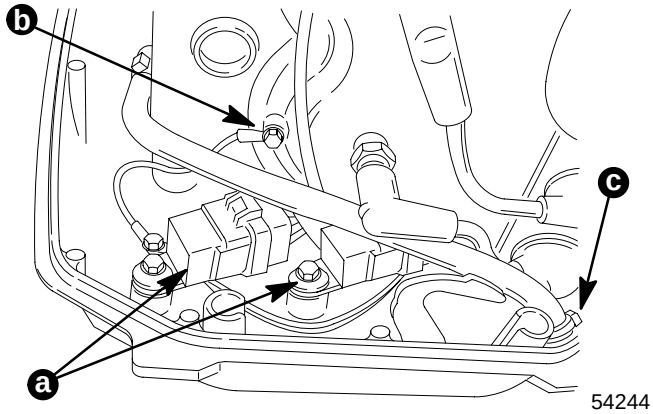
4. Reattach ground wire to powerhead. Connect wires from trim relay switch. Connect tel tale hose.

Design 1



PE-51082

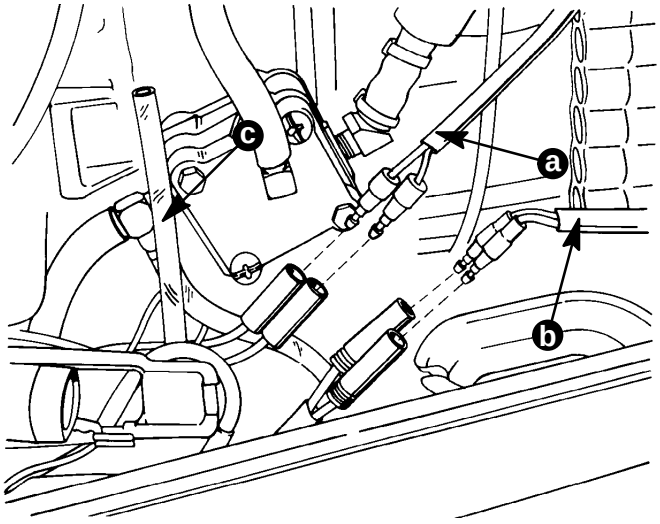
Design 2



54244

a - Module(s)
b - Ground Lead
c - Tel Tale Hose

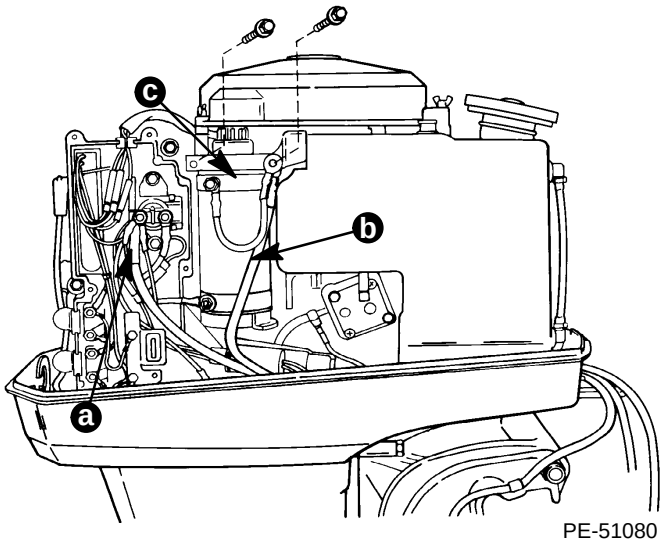
5. Reconnect wires and oil hose. Secure in place with sta-strap.



PE-51088

a - Oil Tank Wires
b - Power Trim Wires
c - Oil Hose (Connect to Tank)

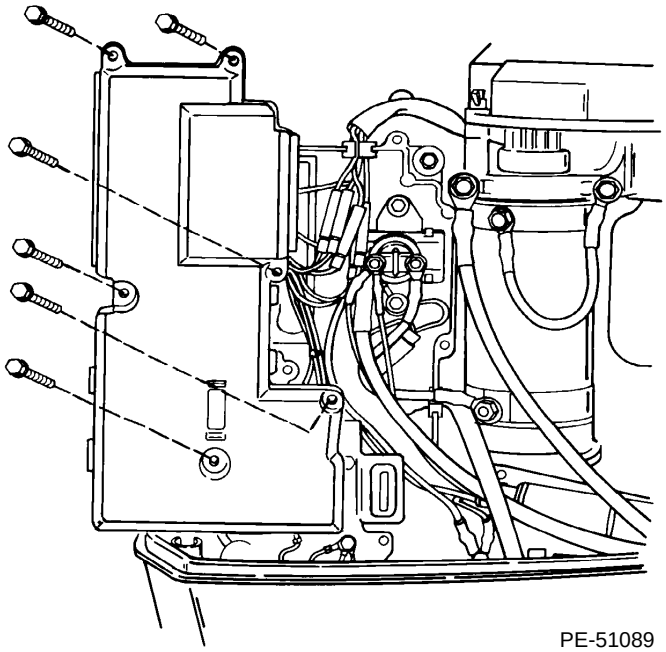
6. Install oil tank.
7. Install battery cables and starter bracket.



PE-51080

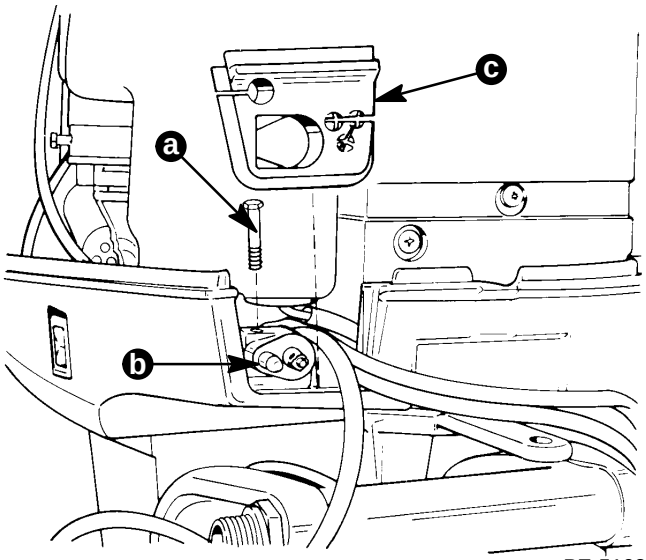
a - Positive Cable
b - Ground Cable
c - Bracket

8. Install electrical box cover. Note, bottom edge of cover fits into groove of plate.



PE-51089

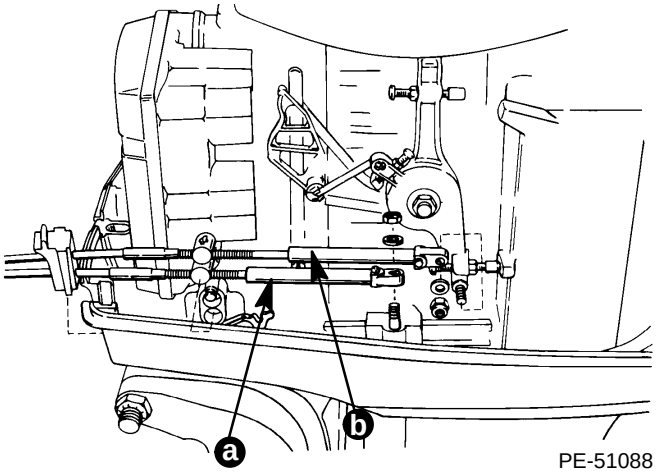
9. Install bolt and rubber grommet.



PE-51082

a - Bolt
b - Fuel Connector
c - Rubber Grommet

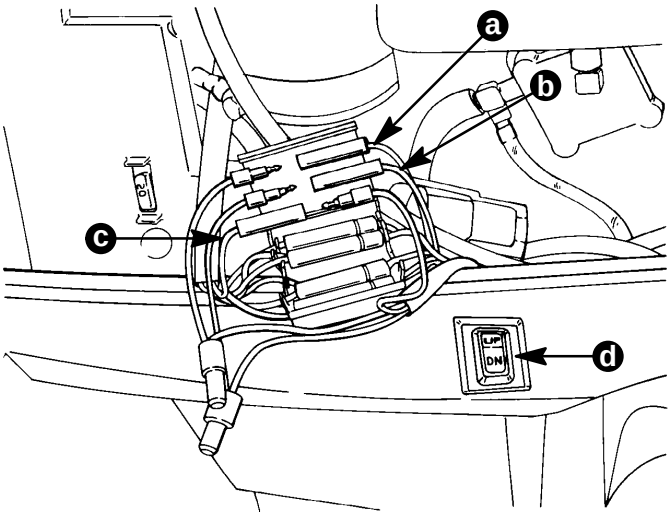
10. Install control cables. Refer to cable adjustment in Section 7A.



PE-51088

a - Shift Cable
b - Throttle Cable

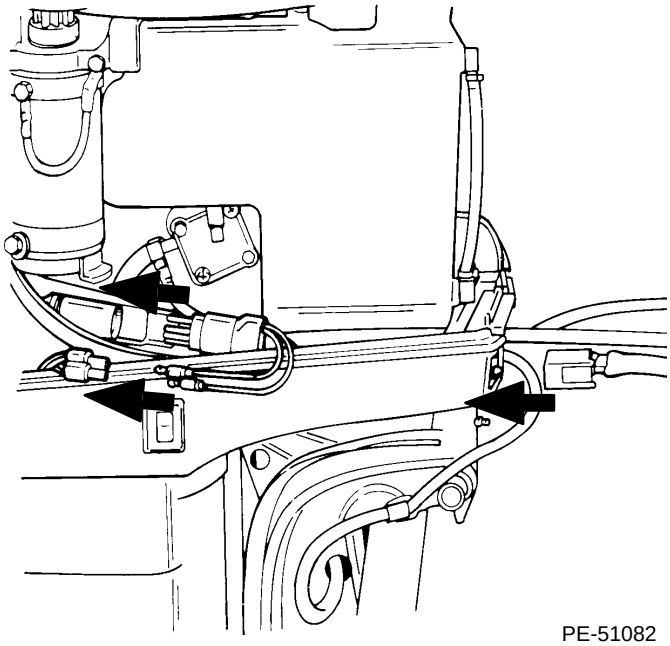
11. Reconnect trim switch.



PE-51089

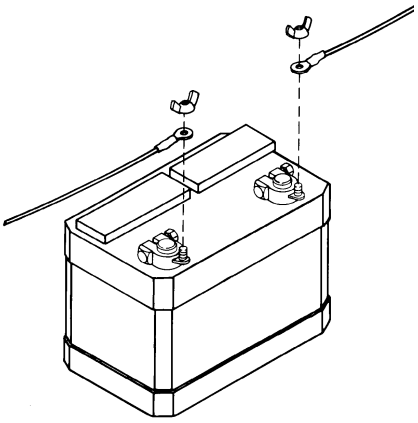
a - Blue/White
b - Green/White
c - Red/Black
d - Trim Switch

12. Connect control/trim harness and fuel line.



PE-51082

13. Install battery cables.



PE-51084

Test Run Procedure

⚠ CAUTION

When engine is started, IMMEDIATELY check that water pump is operating. Operation of water pump is indicated by water discharging from "tell tale".

1. While test running outboard, check powerhead assembly for leaks and/or unusual noises. Make any repairs BEFORE placing outboard in service.

Important Information

Proper break-in assures that all moving parts "wear-in" evenly to ensure a longer engine life and optimum performance.

Operate your new outboard motor at varied throttle settings – not to exceed 1/2 throttle (2500-3500 RPM) during the first hour or the first five gallons of break-in fuel. Refer to "Fuel Mixture and Gasoline/Oil Recommendations" – "Break-In Fuel Mixture" located in your operation and Maintenance Manual.

During the second hour operation, or the second 5 gallons (20 Litres) of break-in fuel, operate the Outboard at varied throttle settings not to exceed 4500 RPM.

DO NOT OPERATE YOUR NEW OUTBOARD MOTOR AT FULL THROTTLE UNTIL THE SECOND HOUR OF BREAK-IN IS COMPLETED. This includes full throttle acceleration, pulling waterskiers, or wide open throttle running.

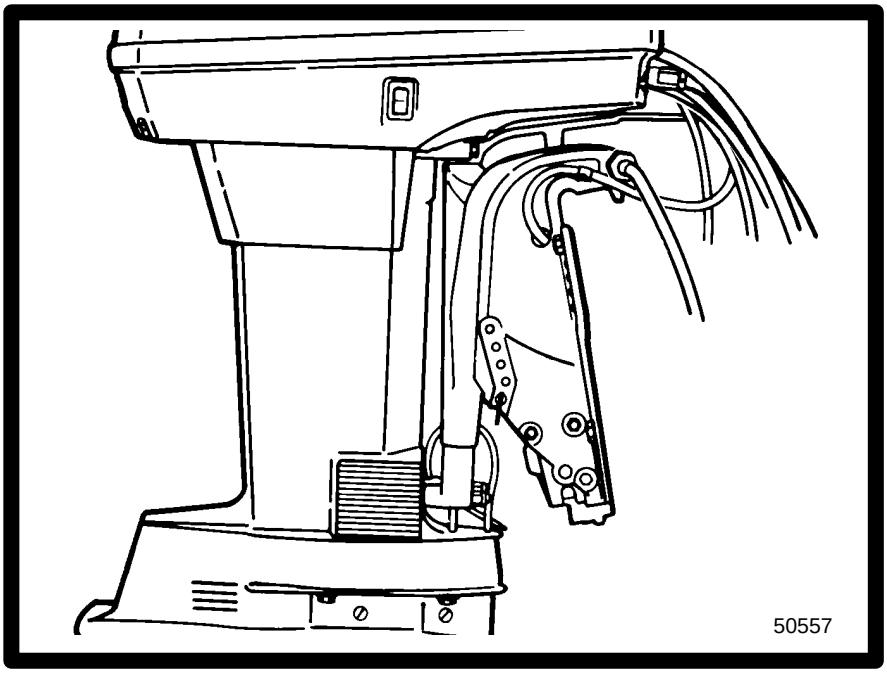
After the first two hours of running, approximately 10 gallons (40 Liters) of fuel, full throttle operation may be attained, but not sustained, for the remaining break-in fuel (approximately 5 gallons).

For the next five hours of operation, full throttle operation may, again, be attained, but it is strongly not recommended for sustained use. (Not more than 5 minutes of continuous wide open throttle.)

⚠ CAUTION

SEVERE DAMAGE to your engine can result by not complying with the preceding break-in procedures.

MID-SECTION



5

A

CLAMP/SWIVEL BRACKETS and DRIVE SHAFT HOUSING

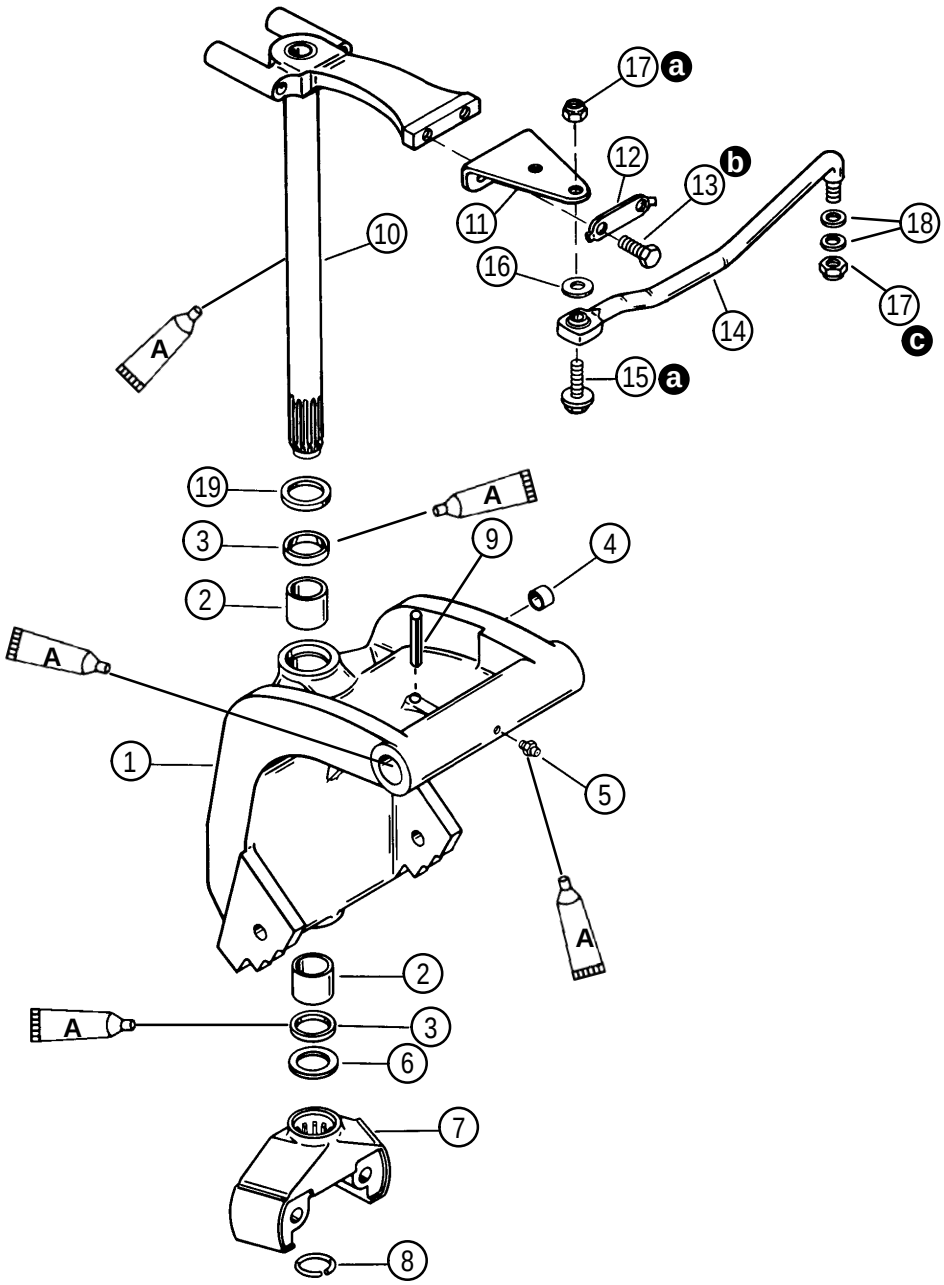
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Tilt Lock Lever/Transom Bracket	5A-5
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Mid-Section Components

Swivel Bracket Components

1 - Swivel Bracket
2 - Bushing (2)
3 - Oil Seal
4 - Bushing
5 - Grease Fitting
6 - Washer (2)
7 - Yoke
8 - Retaining Ring
9 - Roll Pin
10 - Steering Arm
11 - Bracket
12 - Locking Plate
13 - Bolt (2)
14 - Steering Link
15 - Bolt
16 - Spacer
17 - Lock Nut
18 - Washer (2)
19 - Washer (2)



Lubrication/Sealant Application Points

A 2-4-C w/Teflon Marine Lubricant (92-90018A12)

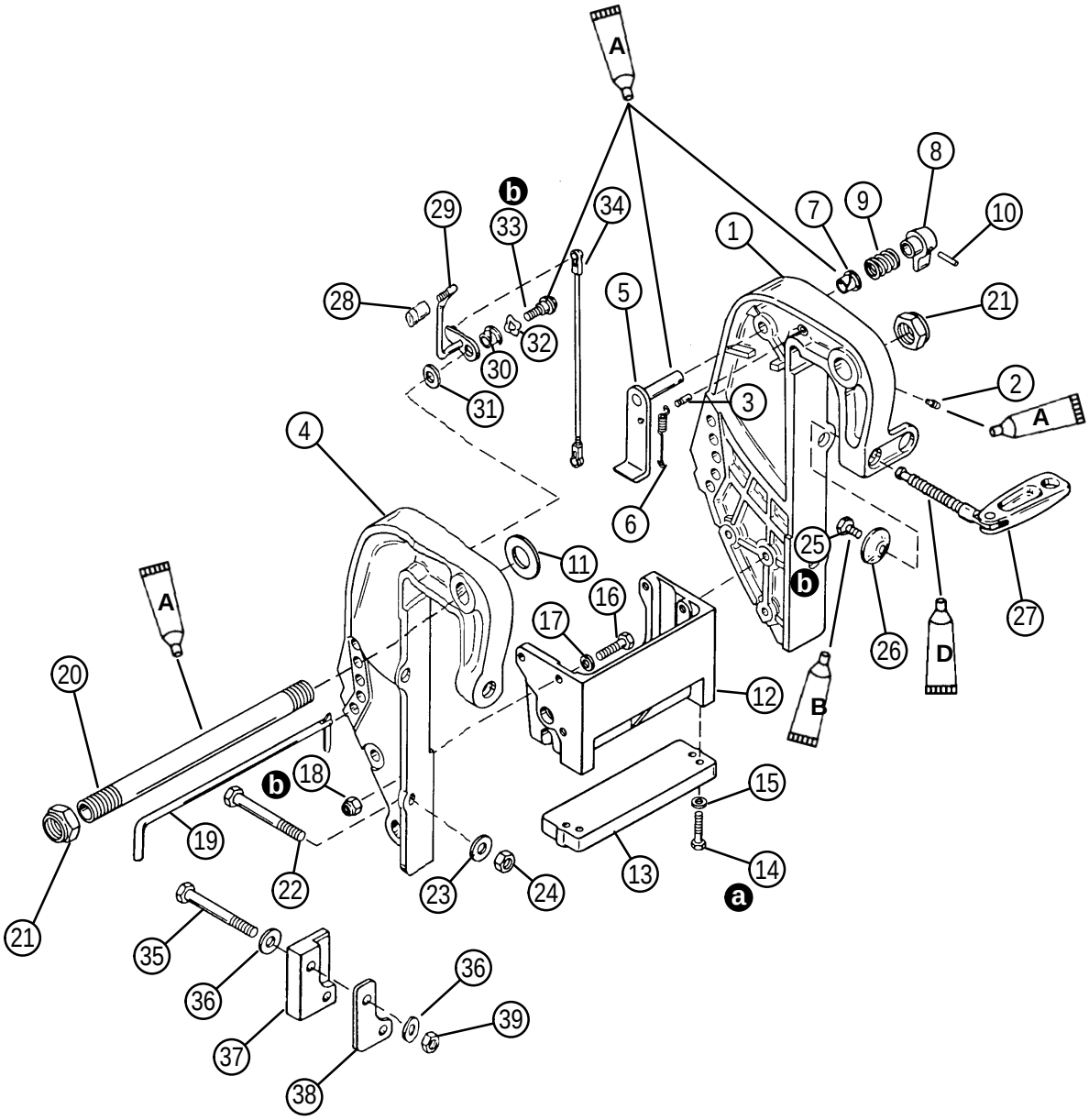
Torque Specifications

a 20 lb. ft. (27.0 N·m)
b 40 lb. ft. (54.0 N·m)
c Torque until it seats, then back off 1/4 turn.

Mid-Section Components

Transom Bracket Components (55 Model)

1 - Transom Bracket
2 - Grease Fitting
3 - Pin
4 - Transom Bracket
5 - Lock Lever
6 - Spring
7 - Bushing
8 - Spring
9 - Lever
10 - Roll Pin
11 - Washer (2)
12 - Bracket
13 - Anode
14 - Bolt (2)
15 - Washer (2)
16 - Bolt:
5 (30mm)
1 (35mm)
17 - Lockwasher (2)
18 - Lock Nut (2)
19 - Pin
20 - Tilt Tube
21 - Lock Nut (2)
22 - Bolt (4)
23 - Washer (4)
24 - Nut (4)
25 - Bolt (2)
26 - Washer (2)
27 - Thumb Screw (2)
28 - Rubber Grip
29 - Tilt Lever
30 - Bushing
31 - Washer
32 - Washer
33 - Bolt
34 - Link
35 - Bolt (4)
36 - Washer (8)
37 - Bracket (2)
38 - Shim (4)
39 - Nut (4)



Lubrication/Sealant Application Points

A 2-4-C Marine w/Teflon Lubricant (92-90018A12)

B Loctite 271 (92-823089--1)

D Special Lubricant 101 (92-13872A1)

Torque Specifications

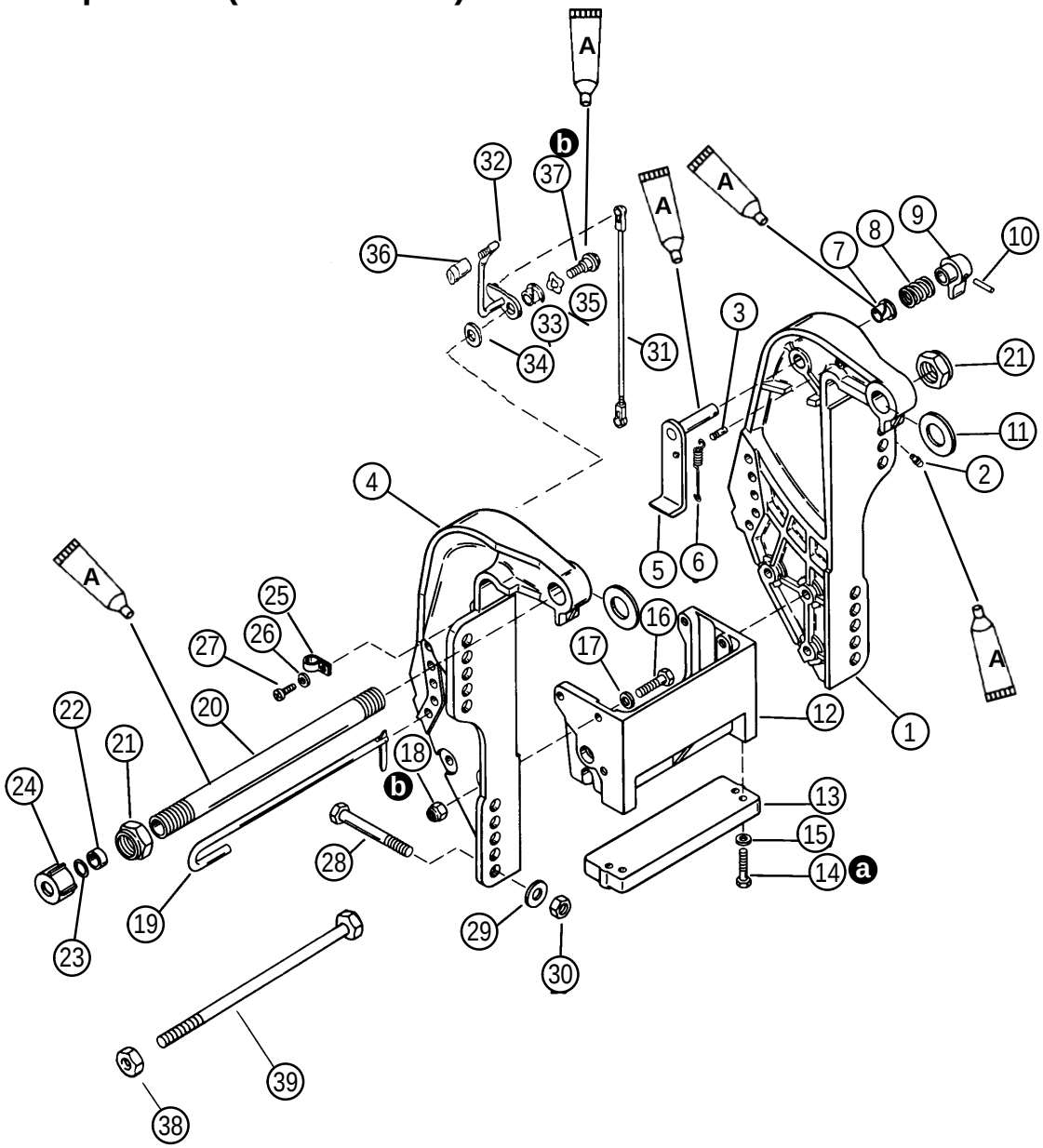
a 60 lb. in. (7.0 N·m)

b 25 lb. ft. (34.0 N·m)

Mid-Section Components

Transom Bracket Components (50/60 Models)

1 - Transom Bracket
2 - Grease Fitting
3 - Pin
4 - Transom Bracket
5 - Tilt Lock Lever
6 - Spring
7 - Bushing
8 - Spring
9 - Lever
10 - Roll Pin
11 - Washer (2)
12 - Bracket
13 - Anode Plate
14 - Bolt (2)
15 - Washer (2)
16 - Bolt:
5 (30mm)
1 (35mm)
17 - Lockwasher (2)
18 - Lock Nut (2)
19 - Pin
20 - Tilt Tube
21 - Lock Nut (2)
22 - Spacer
23 - O-ring
24 - Cap
25 - Clamp
26 - Washer
27 - Screw
28 - Bolt (4)
29 - Washer (4)
30 - Nut (4)
Non-Power Trim
31 - Link
32 - Tilt Lever
33 - Bushing
34 - Washer
35 - Wave Washer
36 - Knob
37 - Bolt
38 - Nut
39 - Bolt



Lubrication/Sealant Application Points

A 2-4-C w/Teflon Marine Lubricant (92-90018A12)

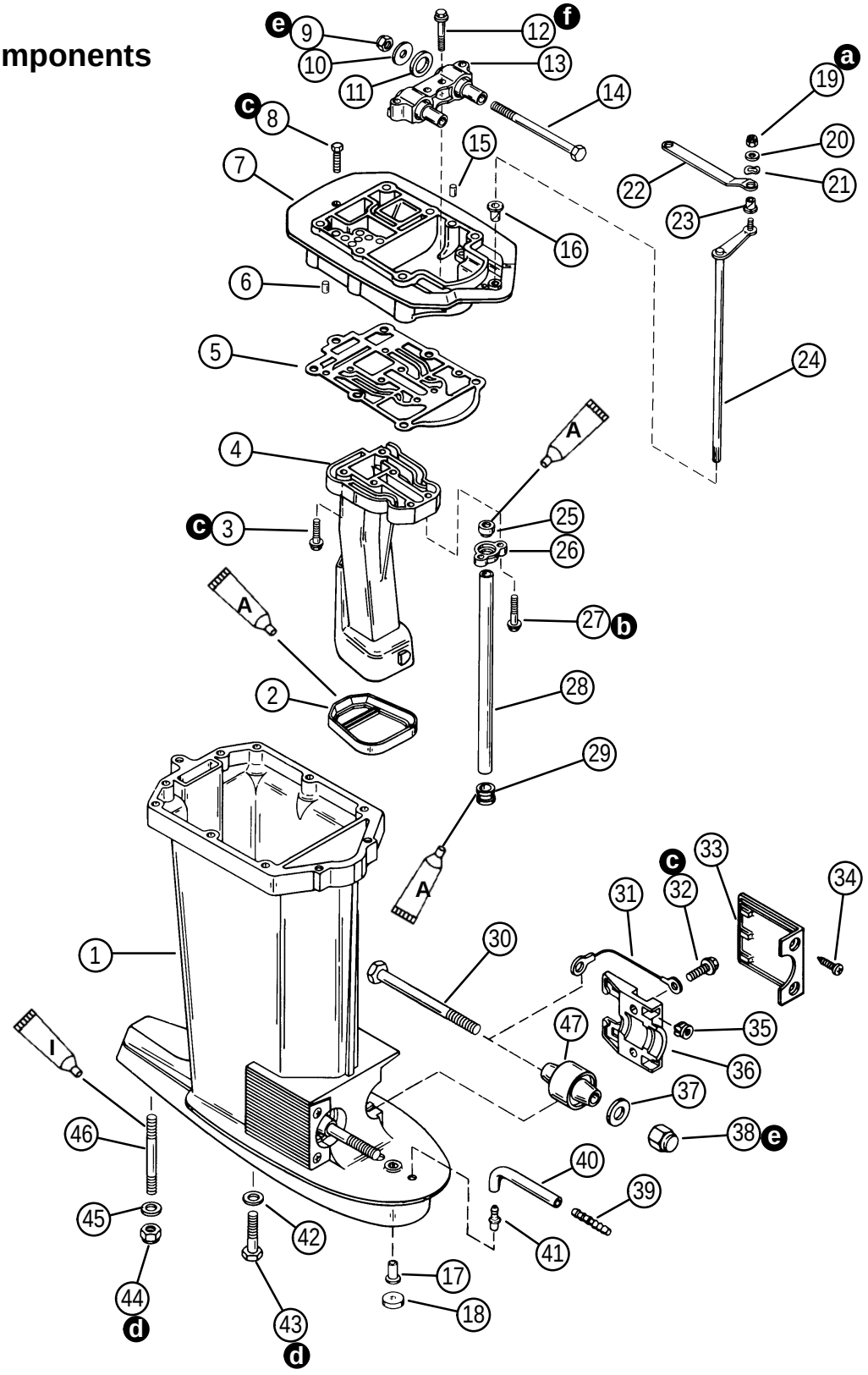
Torque Specifications

a 60 lb. in. (7.0 N·m)
b 25 lb. ft. (34.0 N·m)

Mid-Section Components

Drive Shaft Housing Components

1 - Drive shaft Housing
2 - Seal
3 - Bolt (4)
4 - Exhaust Tube
5 - Gasket
6 - Pin
7 - Exhaust Plate
8 - Bolt
9 - Lock Nut (2)
10 - Washer (2)
11 - Washer (2)
12 - Bolt (4)
13 - Mount
14 - Bolt (2)
15 - Pin (4)
16 - Bushing
17 - Coupling
18 - Spacer
19 - Lock Nut
20 - Washer
21 - Wave Washer
22 - Shift Link
23 - Bushing
24 - Shift Shaft
25 - Seal
26 - Clamp
27 - Bolt (2)
28 - Water Tube
29 - Seal
30 - Bolt (2)
31 - Ground Strap
32 - Bolt (4)
33 - Cover (2)
34 - Screw (4)
35 - Nut (4)
36 - Clamp (2)
37 - Washer (2)
38 - Nut (2)
39 - Connector
40 - Tube
41 - Fitting
42 - Washer (4)
43 - Bolt (4)
44 - Lock Nut
45 - Washer
46 - Stud
47 - Mount (2)



Torque Specification

- (a) No Torque Requirement - Drive Unit Until Tight, But Joint Must Be Free to Pivot
- (b) 80 lb. in. (9.0 N·m)
- (c) 220 lb. in. (25.0 N·m)
- (d) 40 lb. ft. (54.0 N·m)
- (e) 50 lb.ft. (67.5 N·m)
- (f) 28 lb. ft. (38.0 N·m)

Lubrication/Sealant Application Points

- A — 2-4-C w TeflonMarine Lubricant (92-90018A12)
- I — Loctite 35 (92-59328-1)

Disassembly

Remove shock system assembly (refer to Section 5C) from non power trim models.

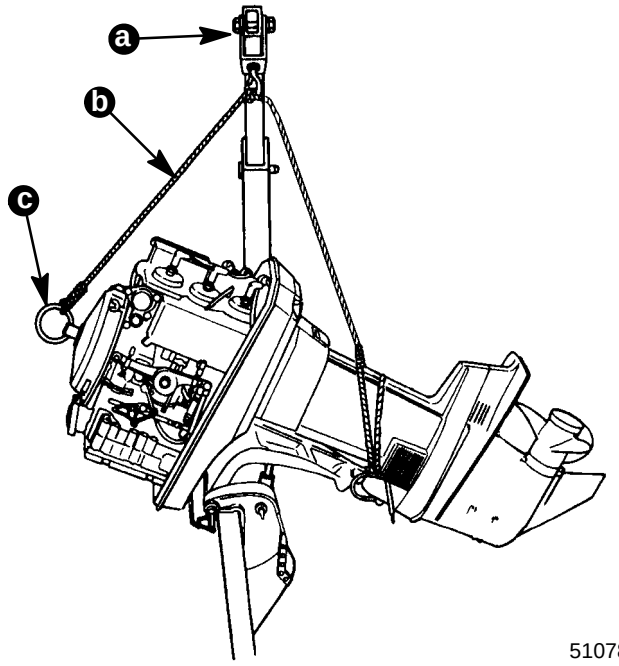
Remove power trim assembly (refer to Section 5B) from power trim models.

Servicing components such as steering arm, driveshaft housing, exhaust assembly, swivel bracket assembly, etc. generally require powerhead and/or gear housing removal. Refer to appropriate section in service manual. Components such as transom bracket, lower mount bracket, tilt tube and lower engine mounts can be serviced without powerhead/gear housing removal; however, outboard must be supported (shown) before servicing components not requiring powerhead/gear housing removal.

⚠ WARNING

Failure to support outboard as shown could result in personal injury and/or damage to outboard or boat.

Typical Outboard Shown



51078

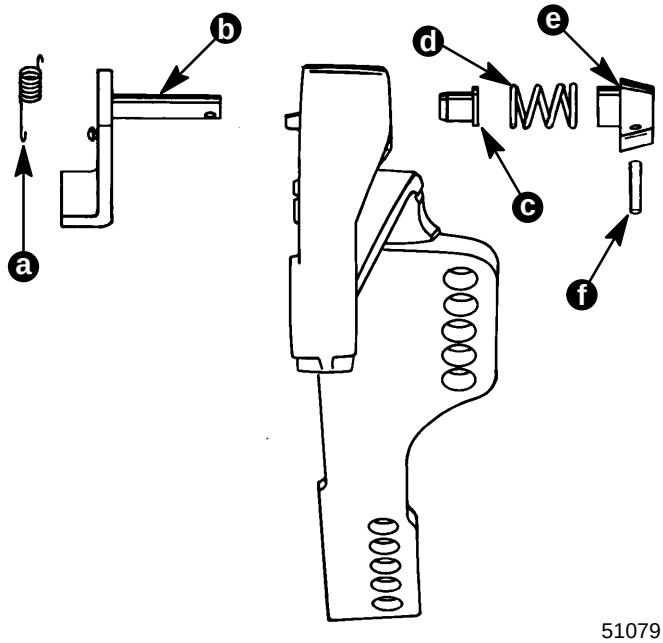
a - Hoist
b - Rope
c - Lifting Eye (P/N 91-90455)

Refer to parts views on pages 1, 2 and 3 and disassemble mid-section components as required.

Reassembly

Tilt Lock Lever/Transom Bracket

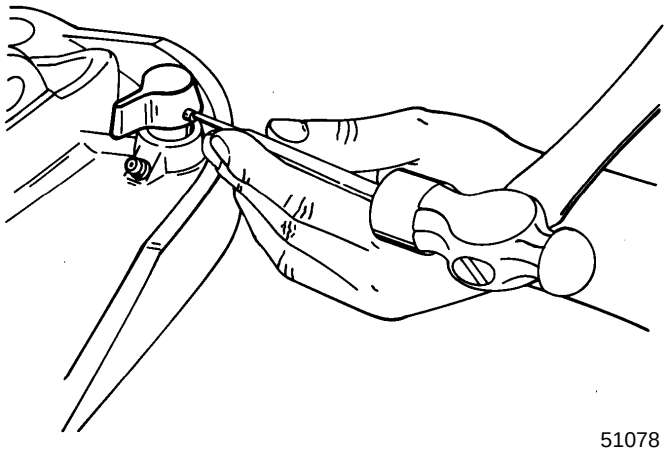
Apply Quicksilver 2-4-C Marine Lubricant to tilt lock lever shank, spacer and bushing prior to reassembly.



51079

a - Spring
b - Tilt Lock Lever
c - Bushing
d - Spring
e - Lever
f - Roll Pin

Install roll pin to tilt lock lever assembly using appropriate punch.



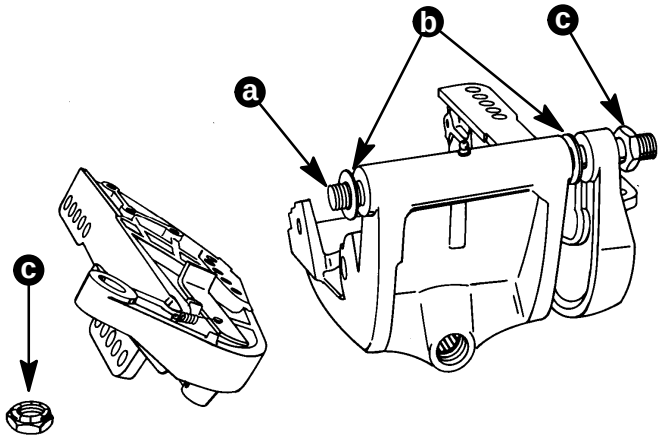
51078

⚠ CAUTION

When reinstalling outboard tilt tube, longer threaded end of tilt tube must extend approximately 3/4 in. (19mm) toward steering cable nut side of boat.

Lubricate outboard tilt tube using Quicksilver 2-4-C Marine Lubricant and install into swivel bracket.

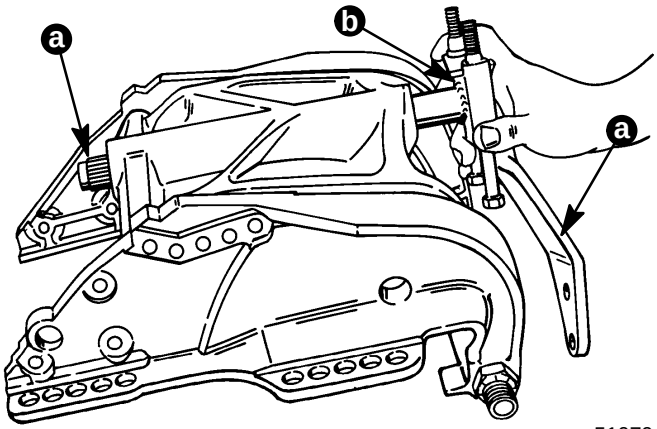
Secure transom brackets into place using fiber washers and lock nuts.



51078

a - Tilt Tube
b - Fiber Washer
c - Lock Nuts

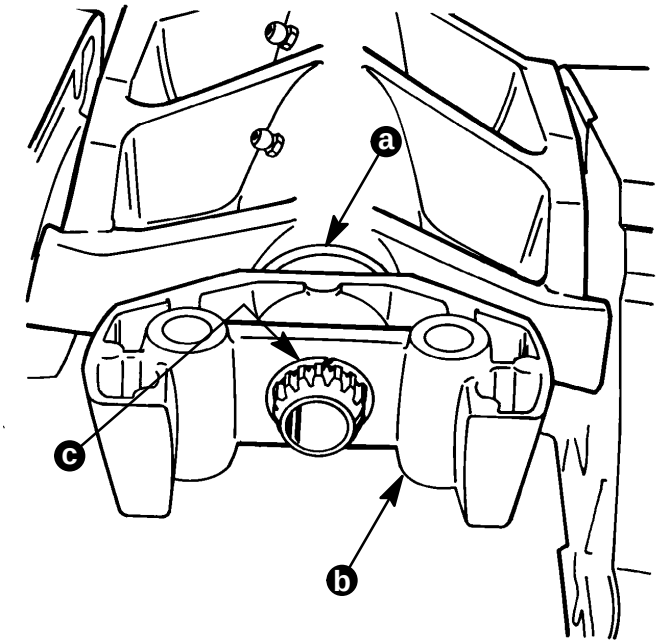
Apply Quicksilver 2-4-C Marine Lubricant to steering arm shaft and install.



51079

a - Steering Arm
b - Washer

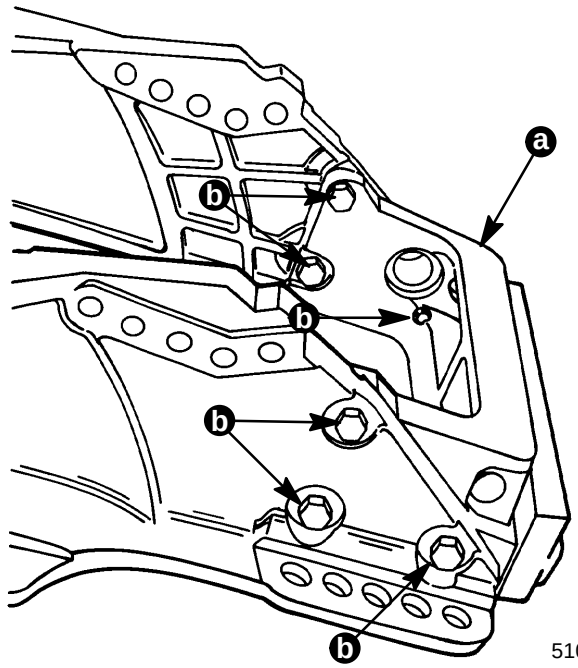
Install and secure yoke and washer using snap ring.



51079

a - Washer
b - Yoke
c - Snap Ring

Install lower mounting bracket to transom brackets.



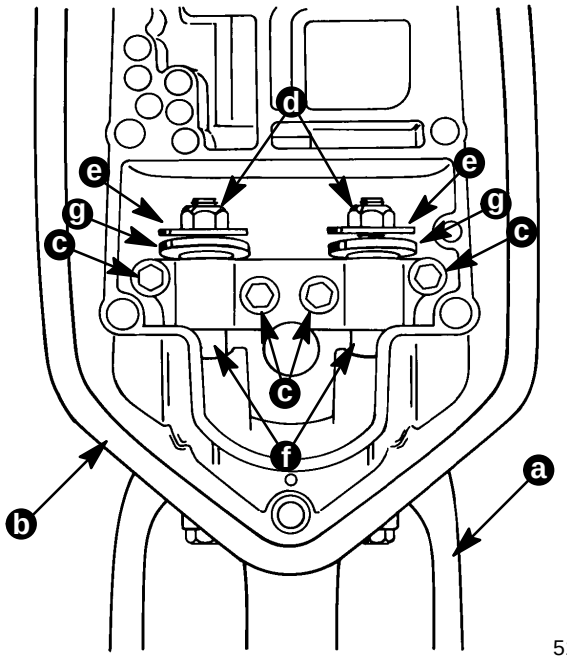
51079

a - Lower Mounting Bracket
b - Bolt

Drive Shaft Housing

Secure transom bracket assembly to transom.

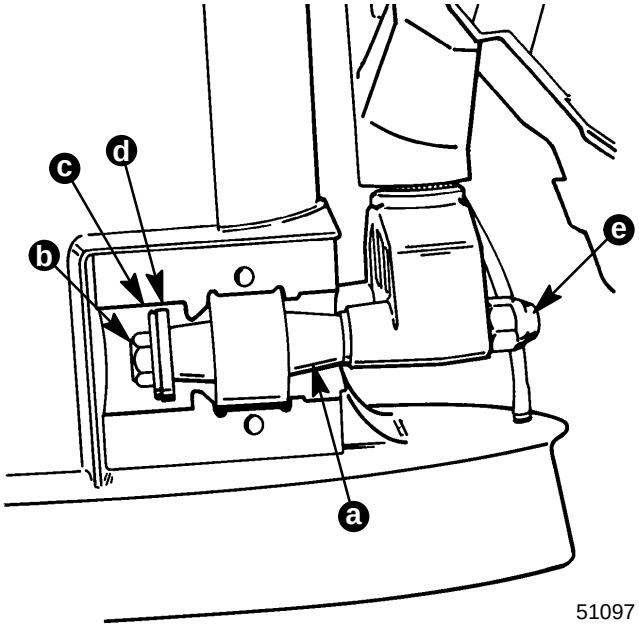
Install drive shaft housing to transom bracket assembly. Secure using bolts and components as shown.



51097

a - Transom Bracket Assembly
b - Drive Shaft Housing Assembly
c - Bolts [28 lb. in. (32 N·m)]
d - Lock Nuts [50 lb. ft. (69 N·m)]
e - Washer
f - Rubber Mount
g - Washer

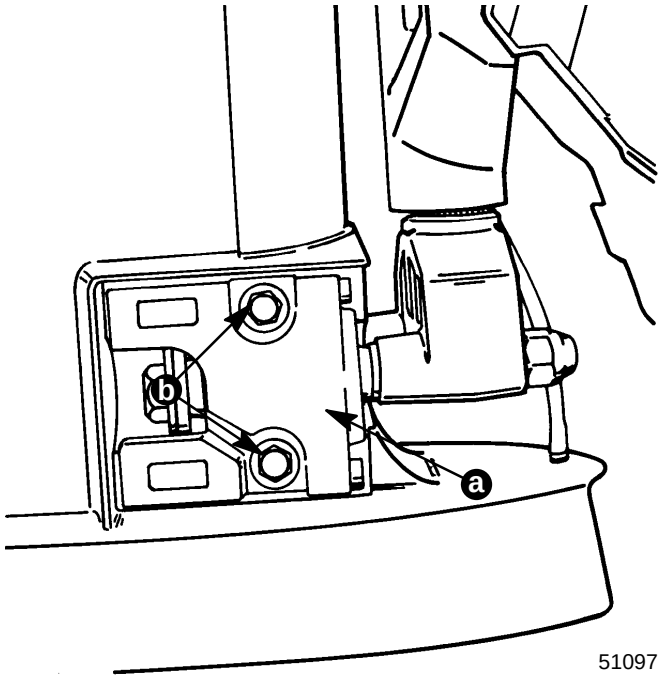
Secure lower mount assembly to drive shaft housing. Secure drive shaft housing to yoke.



51097

a - Lower Mount
b - Bolt
c - Washer
d - Rubber Washer
e - Lock Nut [50 lb. ft. (68 N·m)

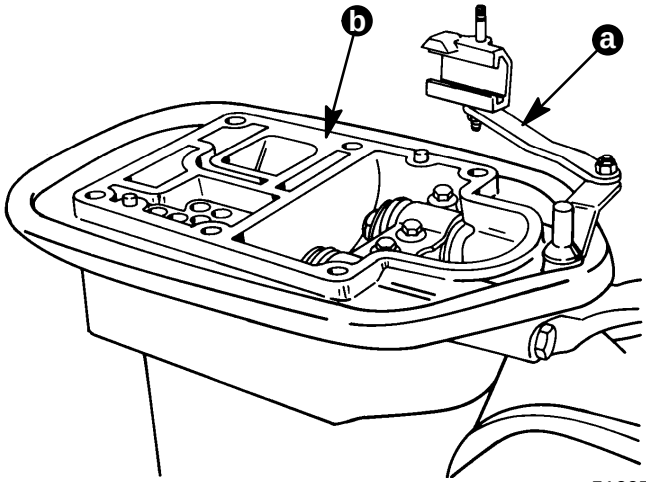
Install clamp.



51097

a - Clamp
b - Bolts [220 lb. in. (24 N·m)]

Install shift linkage assembly and new gasket to drive shaft housing.



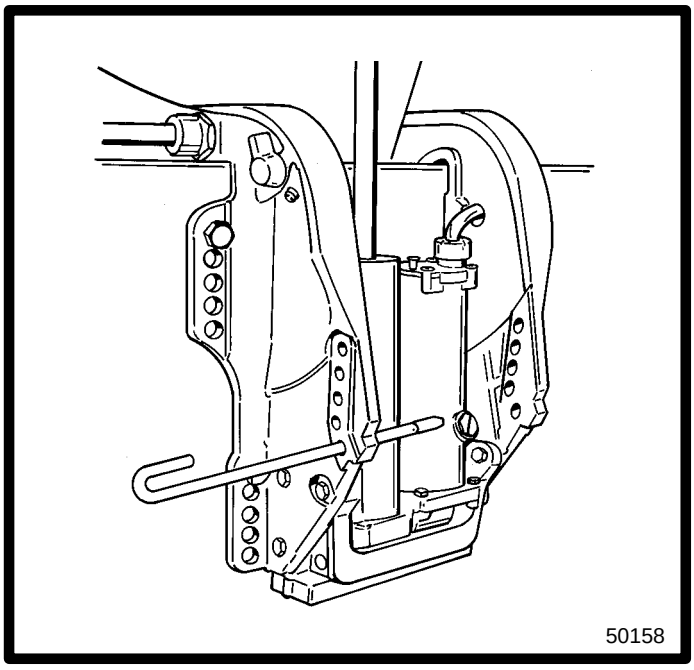
51097

a - Shift Linkage Assembly
b - Gasket

Install powerhead and gearcase assemblies referring to appropriate sections of service manual.

Powerhead Section **4A**
Lower Unit Section **6A**

MID-SECTION



5

B

POWER TRIM (DESIGN 1)

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Power Trim General Information

Description

The Power Trim system consists of an electric motor, pressurized fluid reservoir, pump and trim cylinder.

The remote control (or trim panel) is equipped with a switch that is used for trimming the outboard “up” and “down”, and for tilting the outboard for shallow water operation (at slow speed) or for “trailering”. The outboard can be trimmed “up” or “down” while engine is under power or when engine is not running.

Trimming Characteristics

NOTE: *Because varying hull designs react differently in various degrees of rough water, it is recommended to experiment with trim positions to determine whether trimming “up” or “down” will improve the ride in rough water.*

When trimming your outboard from a mid-trim position (trim tab in neutral, straight fore-and-aft, position), you can expect the following results:

TRIMMING OUTBOARD “UP” (“OUT”)

⚠ WARNING

Excessive trim “out” may reduce the stability of some high speed hulls. To correct instability at high speed, reduce the power gradually and trim the motor “in” slightly before resuming high speed operation. (Rapid reduction in power will cause a sudden change of steering torque and may cause additional momentary boat instability.)

Will lift bow of boat, generally increasing top speed.

Transfers steering torque harder to left on installations below 23” transom height.

Increases clearance over submerged objects.

In excess, can cause porpoising and/or ventilation.

In excess, can cause insufficient water supply to water pump resulting in serious water pump and/or powerhead overheating damage.

⚠ WARNING

Excessive engine trim angle will result in insufficient water supply to water pump causing water pump and/or powerhead overheating damage. Make sure that water level is above gear housing water intake holes whenever engine is running.

Operating “up” circuit will actuate the “up” solenoid (located under engine cowl) and close the electric motor circuit. The electric motor will drive the pump, thus forcing automatic transmission fluid thru internal passageways into the “up” side of the trim cylinder.

The trim cylinder/trim ram will position the engine at the desired trim angle within the 20° maximum trim range. The Power Trim system is designed so the engine cannot be trimmed beyond the 20° maximum trim angle as long as engine RPM is above approximately 2000 RPM.

The engine can be raised beyond the 20° maximum trim angle for shallow water operation, etc., by keeping the engine RPM below 2000 RPM. If engine RPM increases above 2000 RPM, the thrust created by the propeller (if deep enough in the water) will cause the trim system to automatically lower the engine back to the 20° maximum trim angle.

TRIMMING OUTBOARD “DOWN” (“IN”)

⚠ WARNING

Excessive speed at minimum trim “In” may cause undesirable and/or unsafe steering conditions. Each boat should be tested for handling characteristics after any adjustment is made to the tilt angle (tilt pin relocation).

Will help planing off, particularly with a heavy load.

Usually improves ride in choppy water.

In excess, can cause boat to veer to the left or right (bow steer).

Transfers steering torque harder to right (or less to the left).

Improves planing speed acceleration (by moving tilt pin one hole closer to transom).

Operating “Down” circuit will actuate the “down” solenoid (located under engine cowl) and close the electric motor circuit (motor will run in opposite direction of the “Up” circuit). The electric motor will drive the pump, thus forcing automatic fluid thru internal passageways into the “down” side of the tilt ram. The tilt ram will move the engine downward to the desired angle.

Trailering Outboard

⚠ WARNING

Excessive engine trim angle will result in insufficient water supply to water pump causing water pump and/or powerhead overheating damage. Make sure that water level is above gear housing water intake holes whenever engine is running.

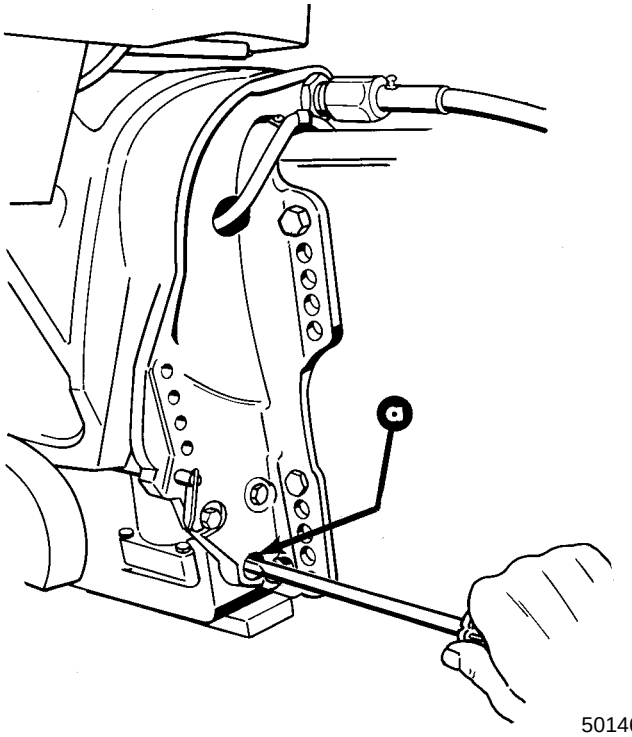
While operating “up” circuit, tilt ram will continue to tilt outboard to full up position for trailering.

Tilting Outboard Up and Down Manually

⚠ WARNING

Before loosening the manual release valve, make sure all persons are clear of engine as engine will drop to full “down” position when valve is loosened.

With power trim installed, the outboard can be raised or lowered manually by opening the manual release valve 3 to 4 turns (counterclockwise).



50146

a - Manual Release Valve

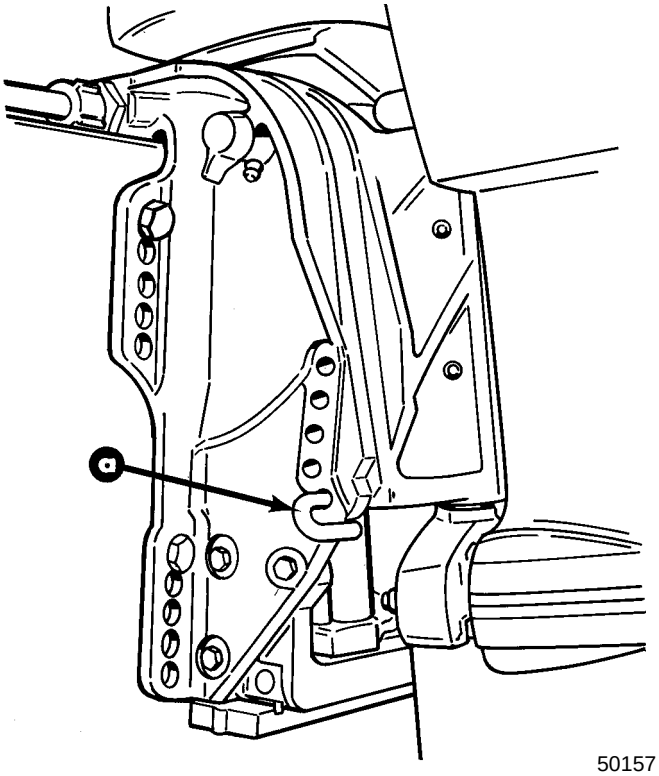
Trim “In” Angle Adjustment

⚠ WARNING

Operating some boats with engine trimmed to the full “in” trim angle [not using trim adjustment pin (a)] at planing speed will cause undesirable and/or unsafe steering conditions. Each boat must be water tested for handling characteristics after engine installation and after any trim adjustments.

IMPORTANT: Some boat/motor combinations, that doe not use the trim adjustment pin (a) and are trimmed to the full “in” trim angle, will not experience any undesirable and/or unsafe steering conditions during planing speed. Thus, not using trim adjustment pin may be desired. However, some boats with engine trimmed to the full “in” trim angle at planing speeds will cause undesirable and/or unsafe steering conditions. If these steering conditions are experienced, under no circumstances should the engine be operated without the trim adjustment pin and without the pin adjusted in the proper holes to prevent unsafe handling characteristics.

Water test the boat not using the trim adjustment pin. If undesirable and/or unsafe steering conditions are experienced (boat runs with nose down), install trim adjustment pin in proper hole to prevent unsafe handling characteristics.



50157

Power Trim System Components

1 - Trim Rod
2 - Dowel Pin (Upper)
3 - Upper Pivot Pin
4 - Rod Wiper
5 - O-ring .671 in. I.D.
6 - Cylinder Cap
7 - O-ring 1.864 in. I.D.
8 - O-ring .614 in. I.D.
9 - Trim Rod Piston
10- Ball (5)
11- Spring Seat (5)
12- Spring (5)
13- Retaining Plate
14- Screw (5)
15- O-ring 1.600 in I.D. (Rod Piston)
16- O-ring 1.600 in. I.D. (Memory Piston)
17- Memory Piston
18- Trim Rod Cylinder
19- Screw (2)
20- O-ring .208 in I.D. (2)
21- Filter
22- O-ring .301 in. I.D.
23- Valve Seat
24- O-ring .364 in. I.D.
25- Ball
26- Spring Guide
27- Spring
28- Dowel Pin (2)
29- Reservoir
30- Fill Screw
31- O-ring .583 in. I.D.
32- Screw (4)
33- Washer (4)
34- O-ring 2.364 in. I.D.
35- Screw
36- Drive Shaft
37- Pump
38- O-ring .176 in. I.D. (2)
39- Dowel Pin
40- Manifold
41- O-ring .114 in. I.D.
42- O-ring .208 in. I.D.
43- O-ring .239 in. I.D.
44- Relief Valve
45- "E" Clip
46- Wire Harness
47- Cap
48- Washer
49- Grommet
50- Screw (4)
51- Screw
52- Reservoir Cap
53- O-ring 2.364 in. I.D.
54- Disk Foam Pad
55- Nut (2)
56- End Cap
57- Washer (.030 in. Thick) (2)
58- Washer, Thrust
59- Armature
60- Washer (.010 in. Thick)
61- Housing
62- O-ring
63- End Frame
64- O-ring .489 in. I.D.
65- Screw (2)

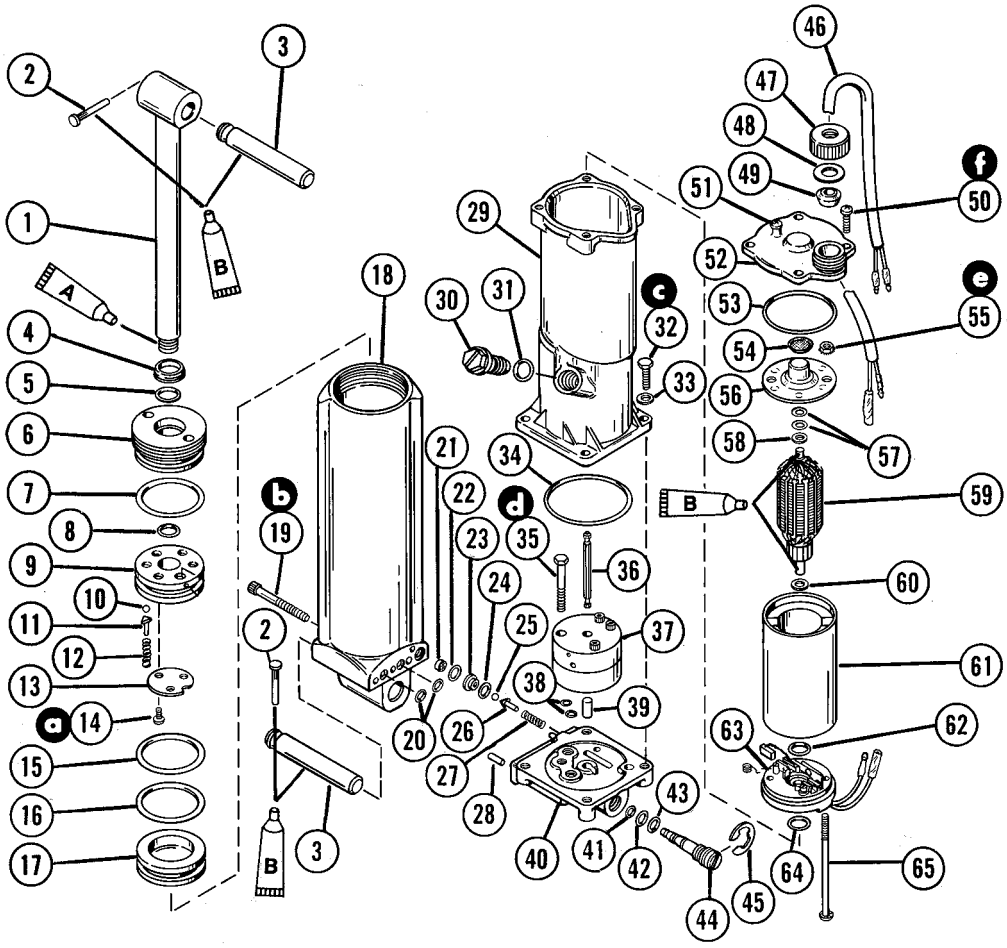
NOTE: *It is recommended that "ALL" O-rings be replaced when servicing tilt system.*

Torque Specifications

- (a) 35 lb. in. (4.0 N·m)
- (b) 100 lb. in. (11.2 N·m)
- (c) 70 lb. in. (7.9 N·m)
- (d) 90 lb. in. (10.2 N·m)
- (e) 25 lb. in. (2.8 N·m)
- (f) 13 lb. in. (1.5 N·m)

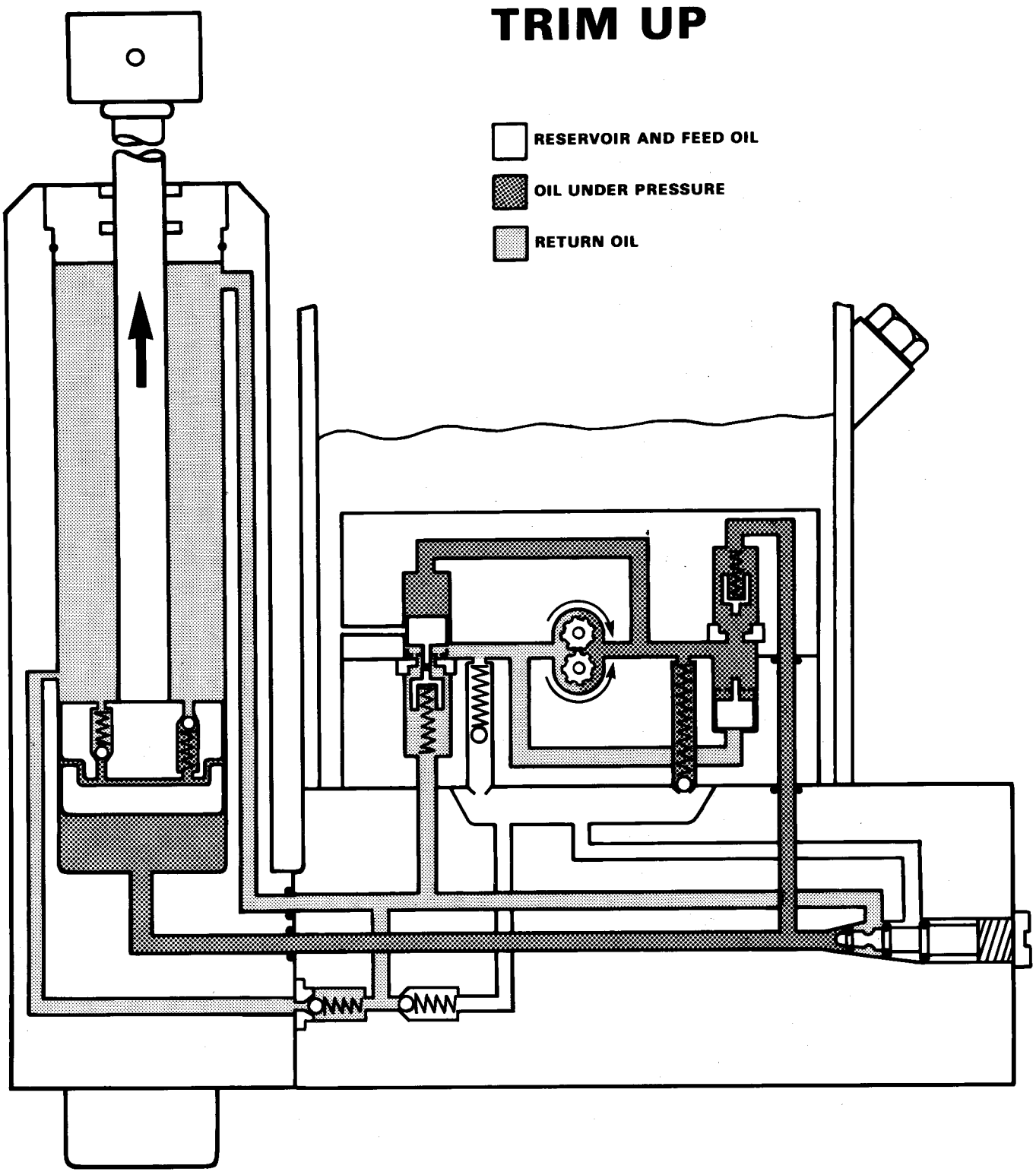
Quicksilver Lubricants and Service Aids

- A — Loctite Grade "A" (271)
- B — 2-4-C Marine Lubricant (92-90018A12)



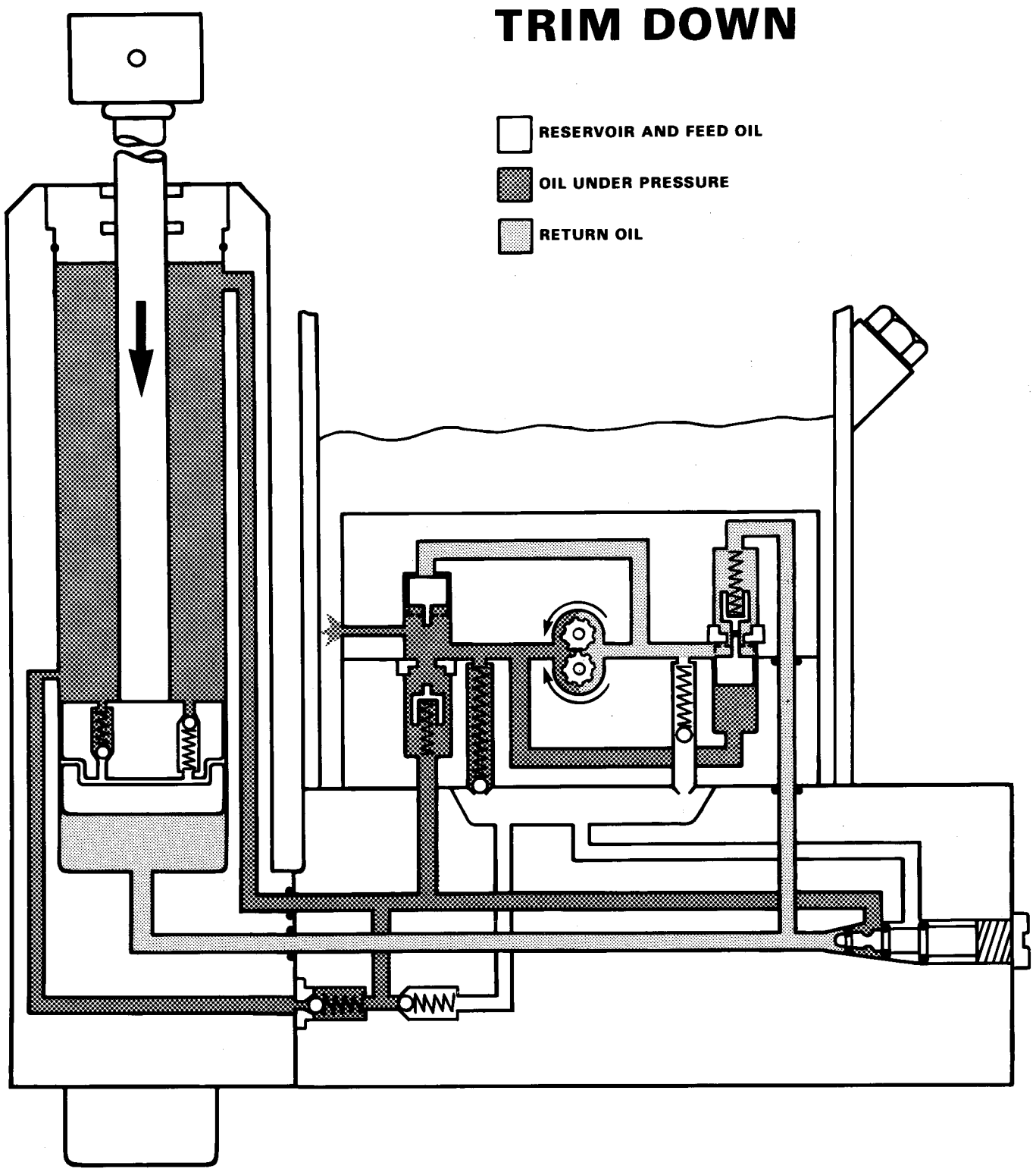
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Power Trim Flow Diagrams
Design 1

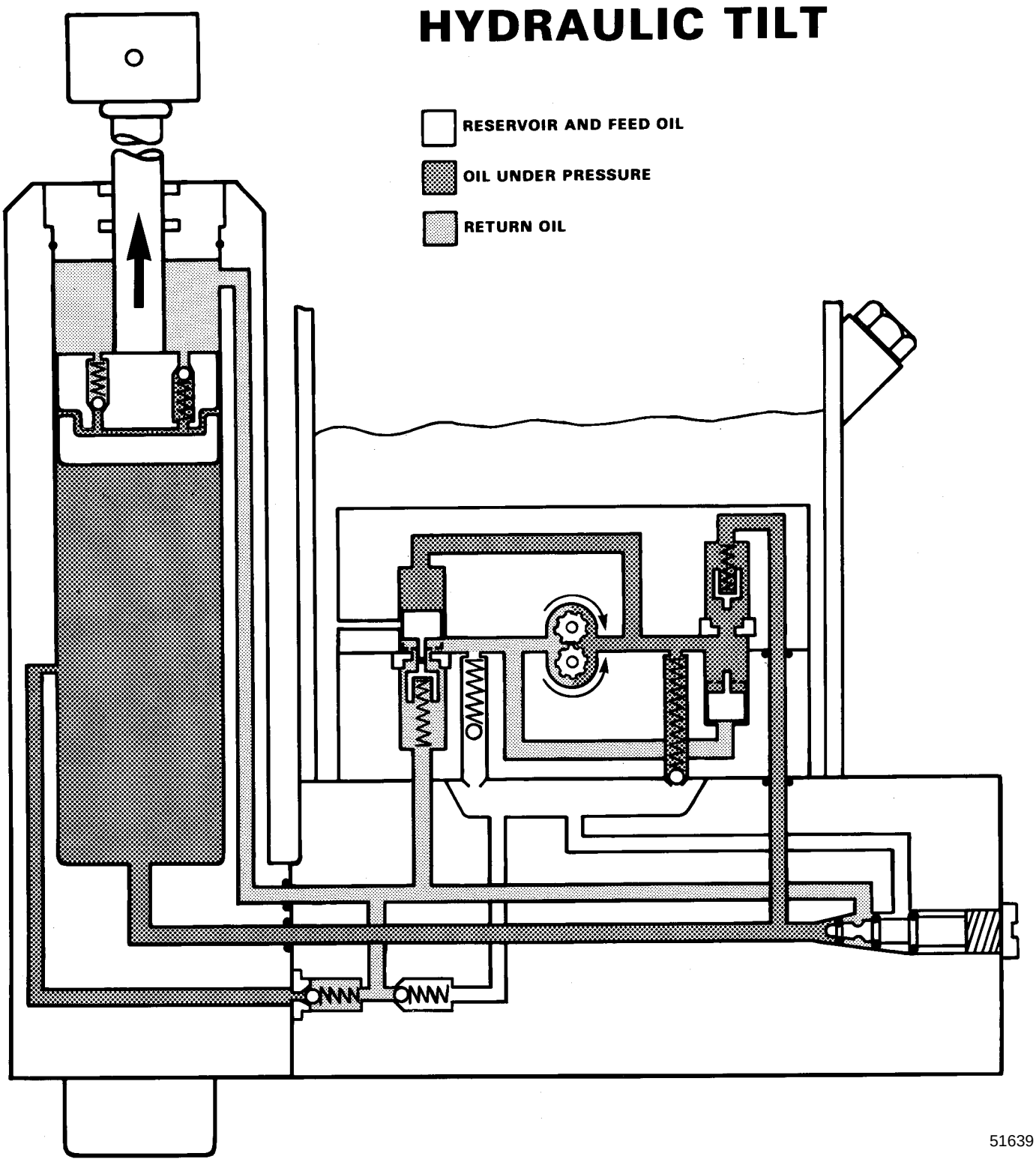


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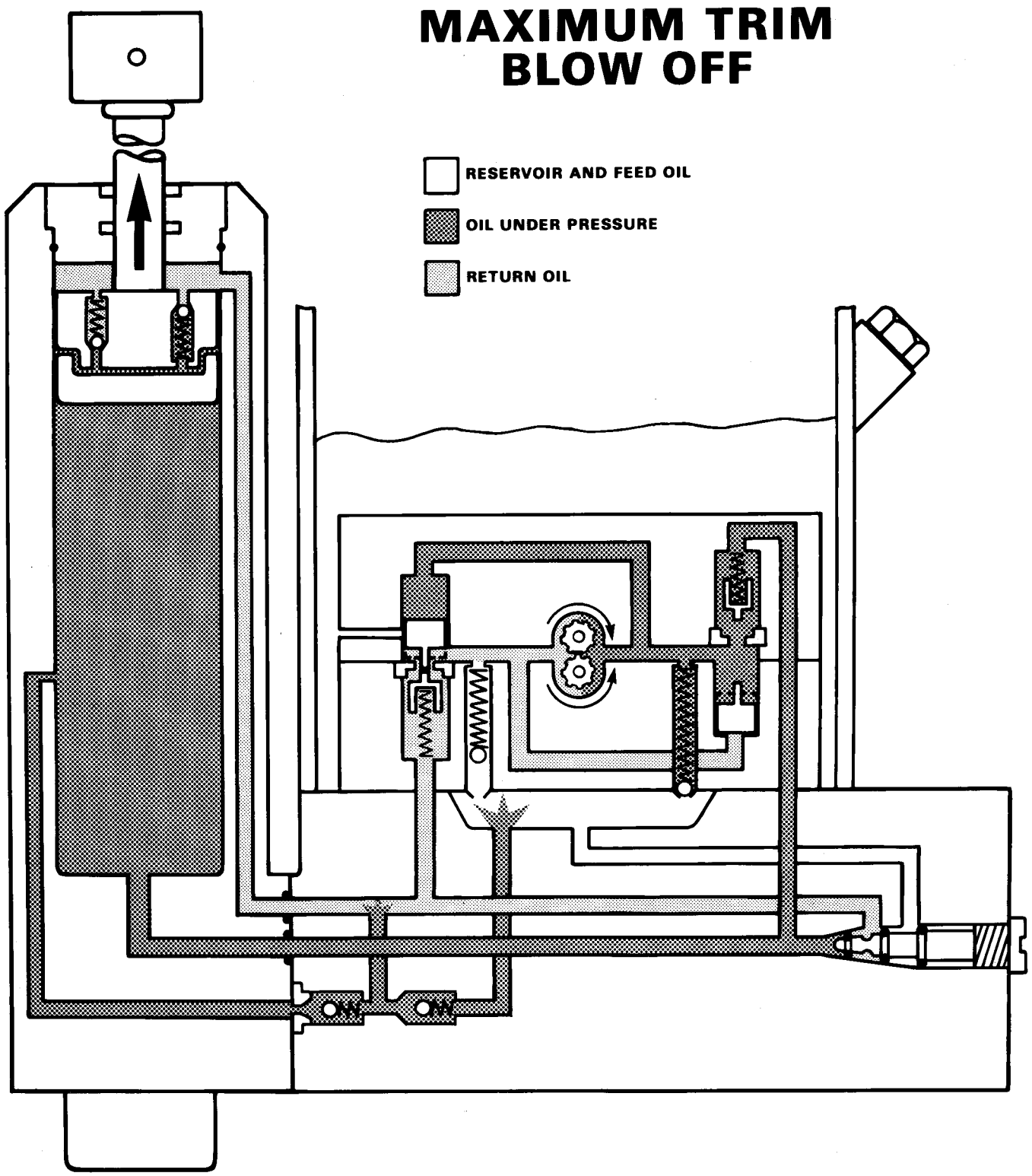
Design 1


TRIM DOWN
RESERVOIR AND FEED OIL
OIL UNDER PRESSURE
RETURN OIL
51637

Design 1

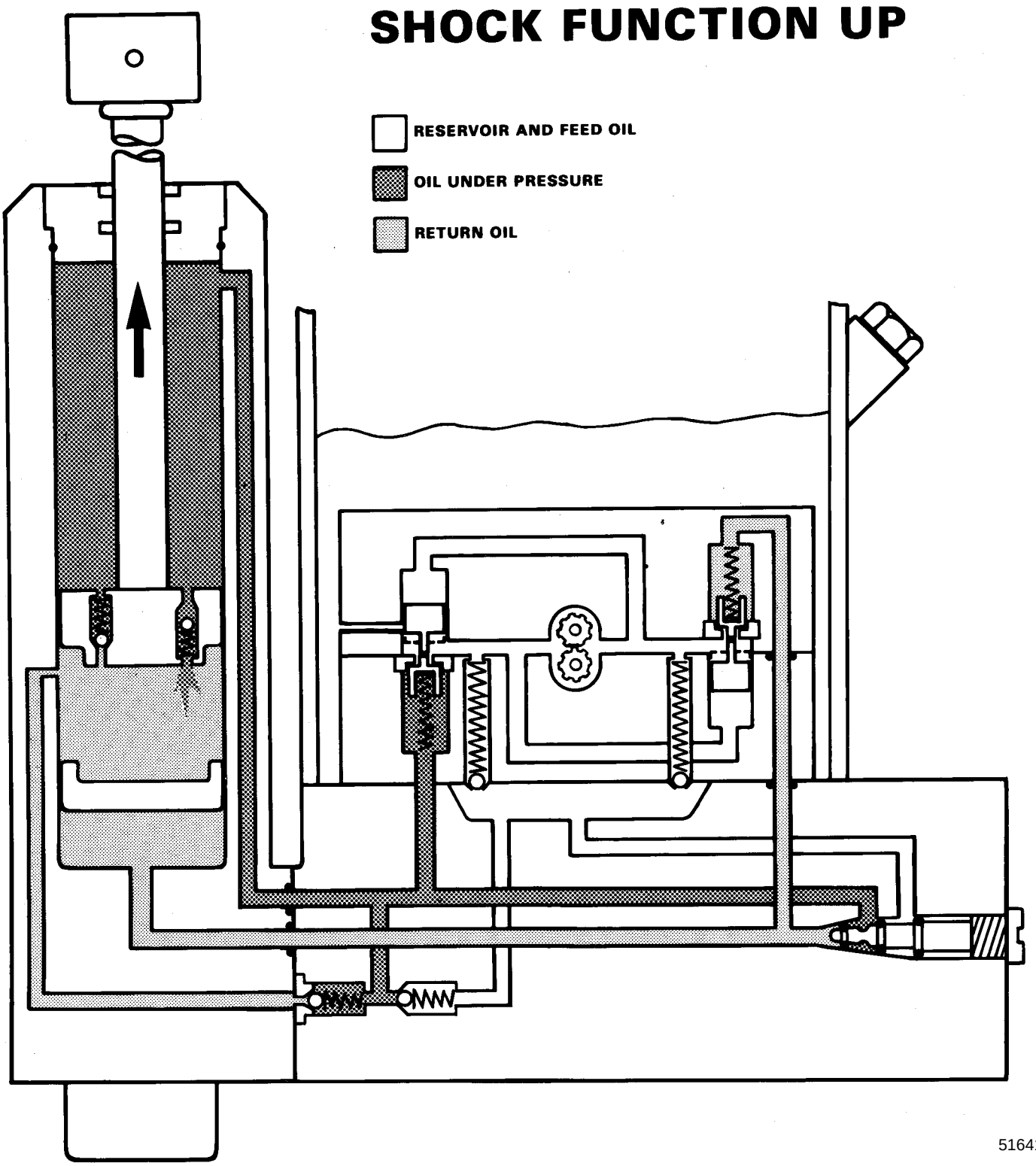

HYDRAULIC TILT
RESERVOIR AND FEED OIL
OIL UNDER PRESSURE
RETURN OIL
51639

Design 1

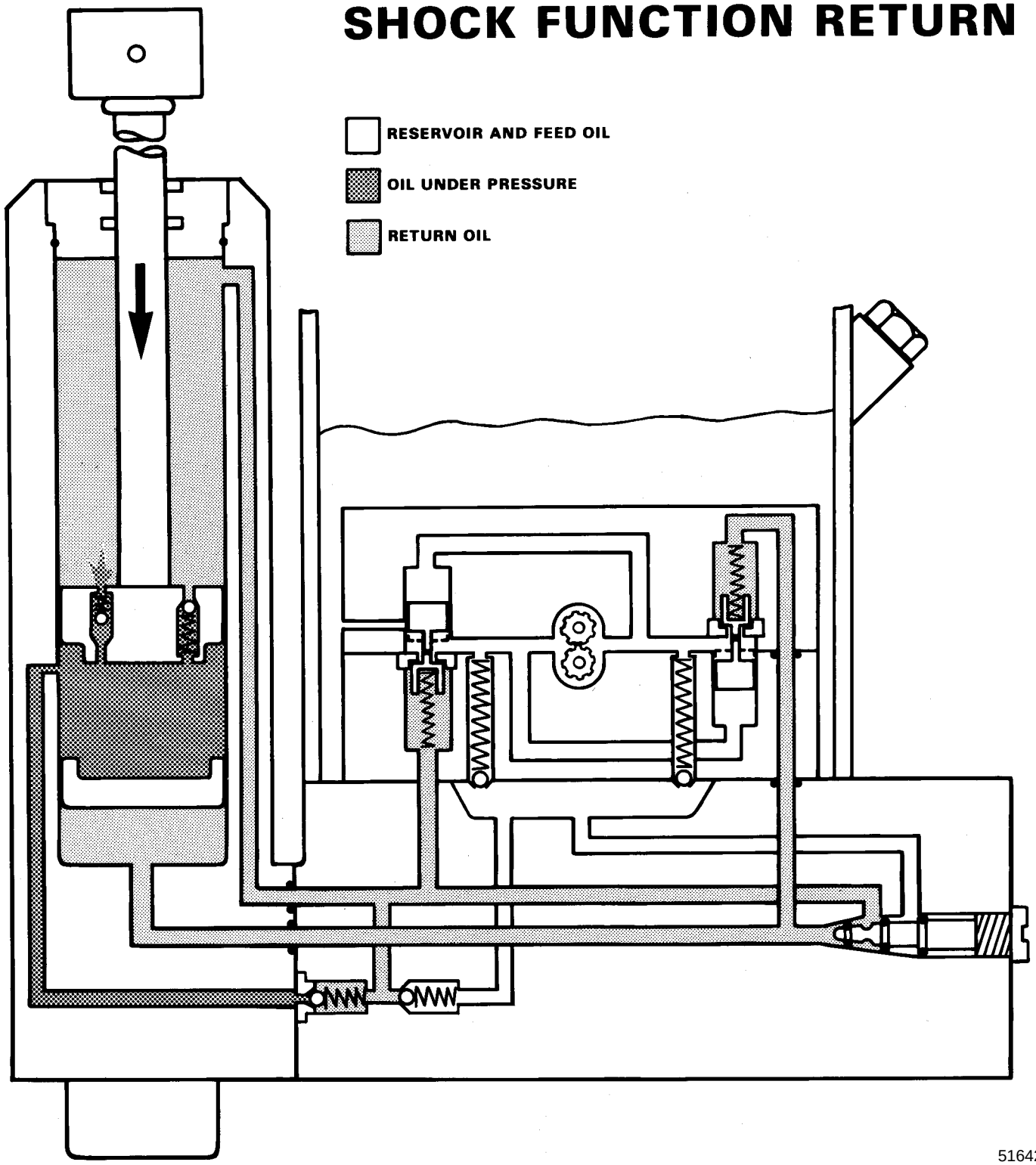


51640

Design 1

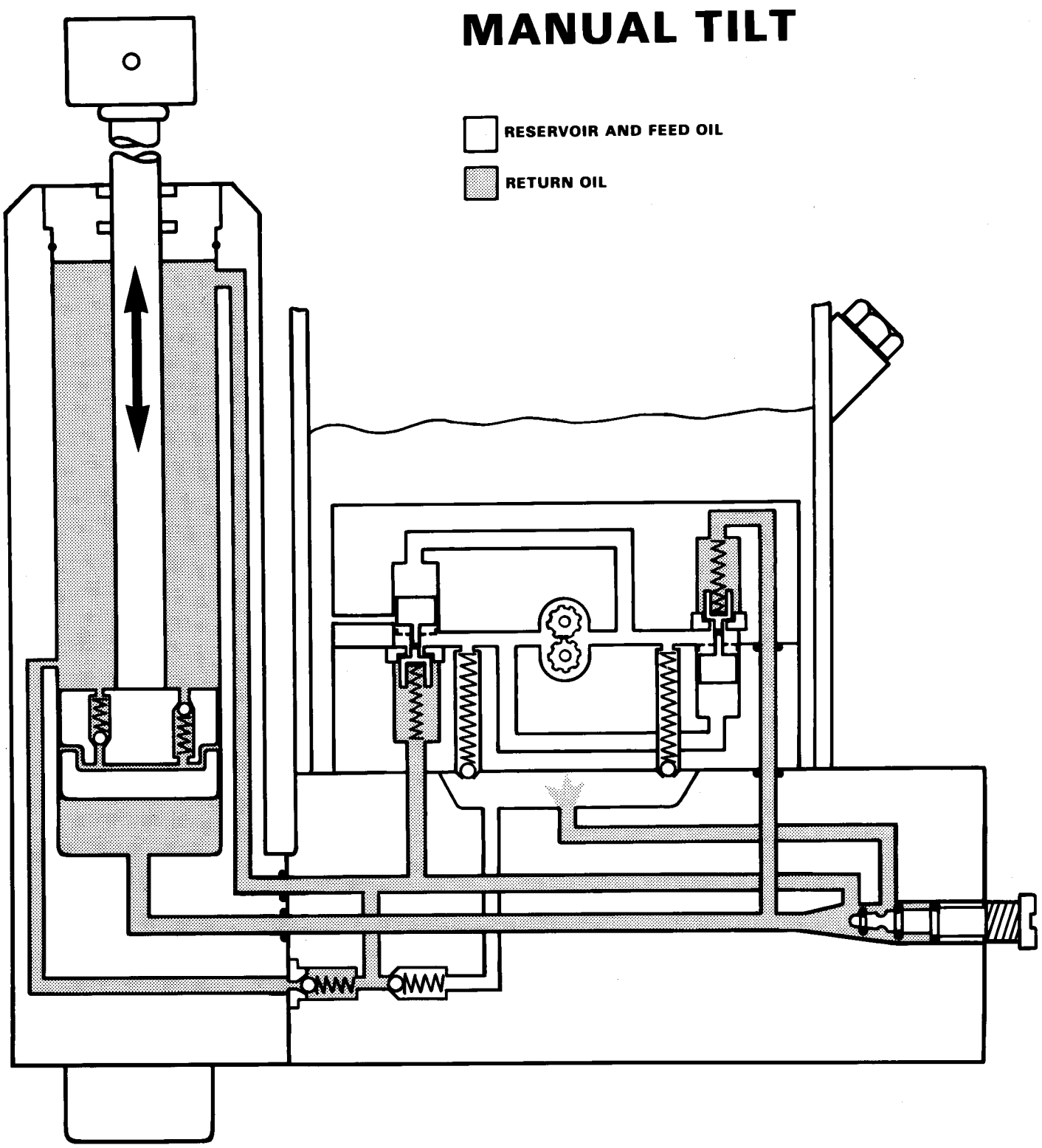

SHOCK FUNCTION UP
RESERVOIR AND FEED OIL
OIL UNDER PRESSURE
RETURN OIL
51641

SHOCK FUNCTION RETURN



51642

Design 1



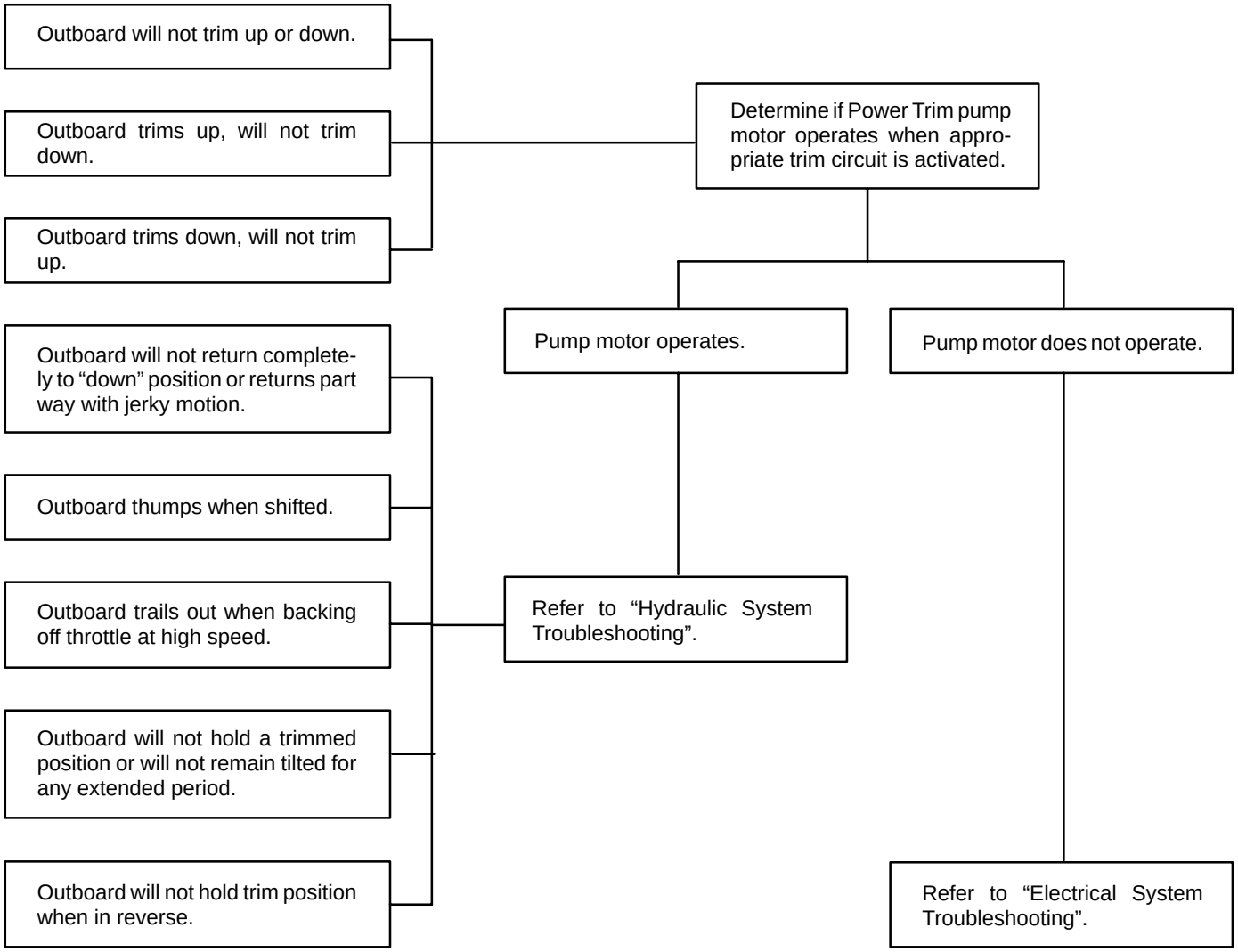
51643

Troubleshooting

Determine if Problem is Electrical or Hydraulic

Refer to the following chart to determine which system is at fault.

Trouble Chart


Outboard will not trim up or down.
Outboard trims up, will not trim down.
Outboard trims down, will not trim up.
Outboard will not return completely to “down” position or returns part way with jerky motion.
Outboard thumps when shifted.
Outboard trails out when backing off throttle at high speed.
Outboard will not hold a trimmed position or will not remain tilted for any extended period.
Outboard will not hold trim position when in reverse.
Determine if Power Trim pump motor operates when appropriate trim circuit is activated.
Pump motor operates.
Pump motor does not operate.
Refer to “Hydraulic System Troubleshooting”.
Refer to “Electrical System Troubleshooting”.

Hydraulic System Troubleshooting

Support outboard with tilt lock lever when servicing power trim system.

IMPORTANT: After debris or failed components have been found (during troubleshooting procedure) it is recommended that unit be disassembled completely and ALL O-rings be replaced. Check ball valve components and castings must be cleaned using engine cleaner and compressed air or replaced prior to reassembly.

IMPORTANT: Power trim system is pressurized. Outboard must be in the full "UP" position (cylinder fully extended) prior to fill screw or manual release valve removal.

Refer to instructions following if disassembly is required.

Follow preliminary checks before proceeding to troubleshooting flow diagrams (following).

Preliminary Checks

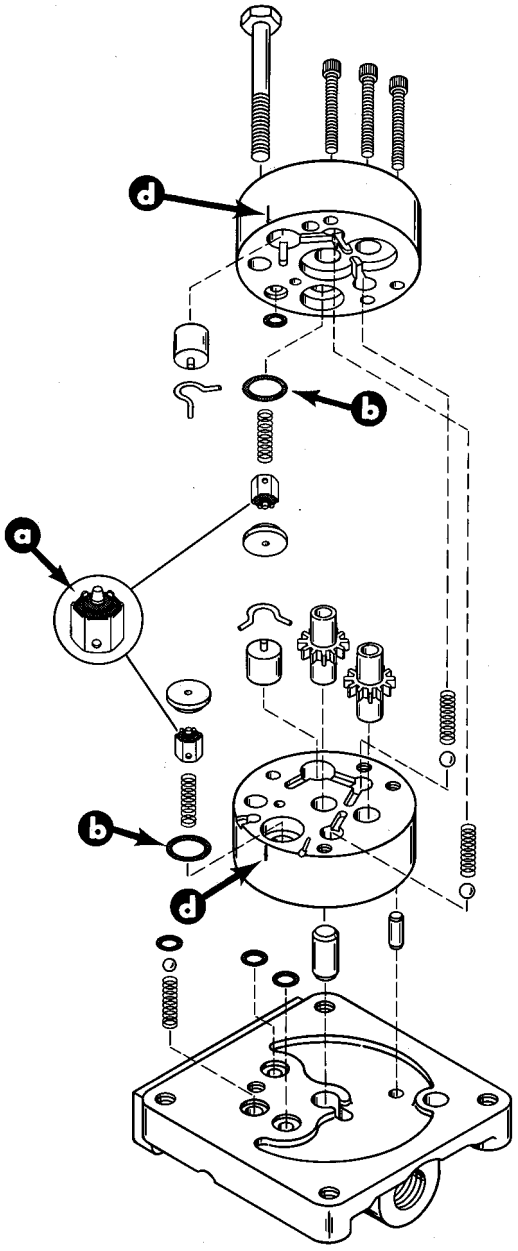
IMPORTANT: Operate Power Trim system after each check to see if problem has been corrected. If problem has not been corrected proceed to next check.

1. Check that manual release valve is tightened to full right (clockwise) position.
2. Check trim pump fluid level with outboard in full "UP" position and fill if necessary. Refer to "Fill and Purge the Power Trim System".
3. Check for external leaks in Power Trim system. Replace defective part(s) if leak is found.
4. Outboard not holding tilted position (falls to trim in position) indicates debris or defective components in trim valve assembly. Clean or replace components as required.
5. Check manual release valve for broken stem and one O-ring remaining in the release valve passage. (Separate the manifold assembly from the cylinder to dislodge broken stem.) Install new release valve and test system.
6. Check for nicked, deteriorated or misplaced O-rings throughout trim system.

Leak Down Check – Pump and Manifold Assembly

NOTE: *Scribe (d) pump housing halves before disassembly.*

1. Debris or chips between valve and seat (a). Usually imbedded in rubber valve seat.
2. Nicked or deteriorated O-ring (b).
3. Nicked, deteriorated or misplaced O-ring between manifold and trim cylinder. Refer to **"Manifold Removal"** for O-ring location.



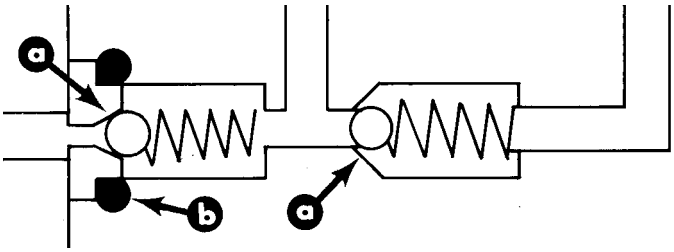
51735

4. After reassembly, insert driveshaft and check pump rotation resistance to turning – housing halves can shift/turn during reassembly. Align scribe marks (d) carefully.

Leak Down Check – Pilot Valve Assembly

1. Debris or chips between check ball and seat (a), usually imbedded in rubber valve seat.
2. Nicked or deteriorated O-ring (b).

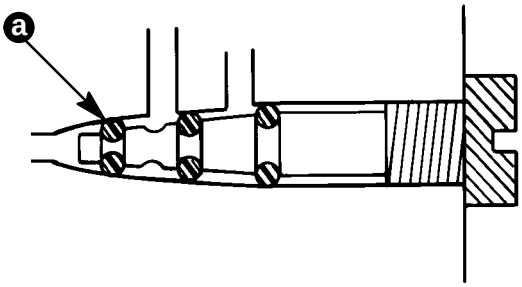
A leak path is created between the UP side of the cylinder and the reservoir. The trim system will leak DOWN until the trim port in cylinder is covered.



a - Check Ball and Seat
b - O-ring

Leak Down Check – Manual Release Valve

1. Debris or chips under O-ring (a).
2. Flash from valve molding causing O-ring (a) to not seal.
3. Nicked O-ring (a).



51560

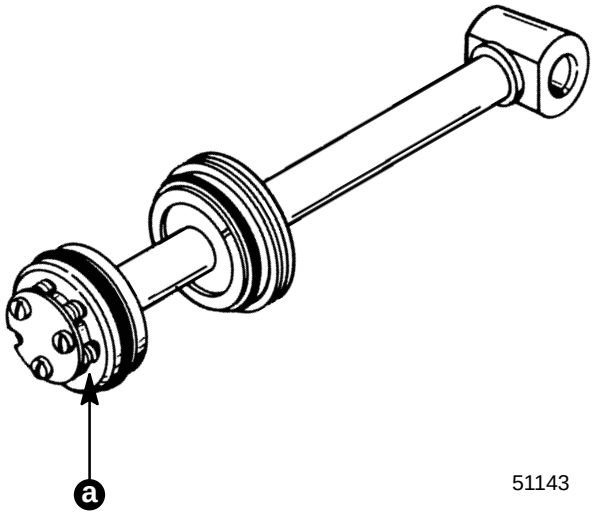
a - O-ring

Leakage Past Ball and Seat – Piston Assembly

Unit will trim to full or near full DOWN position and then will begin to trim UP while trim switch is held in "DOWN" mode.

If trim switch is released, outboard can be pushed (by hand) DOWN to the point where trim UP started.

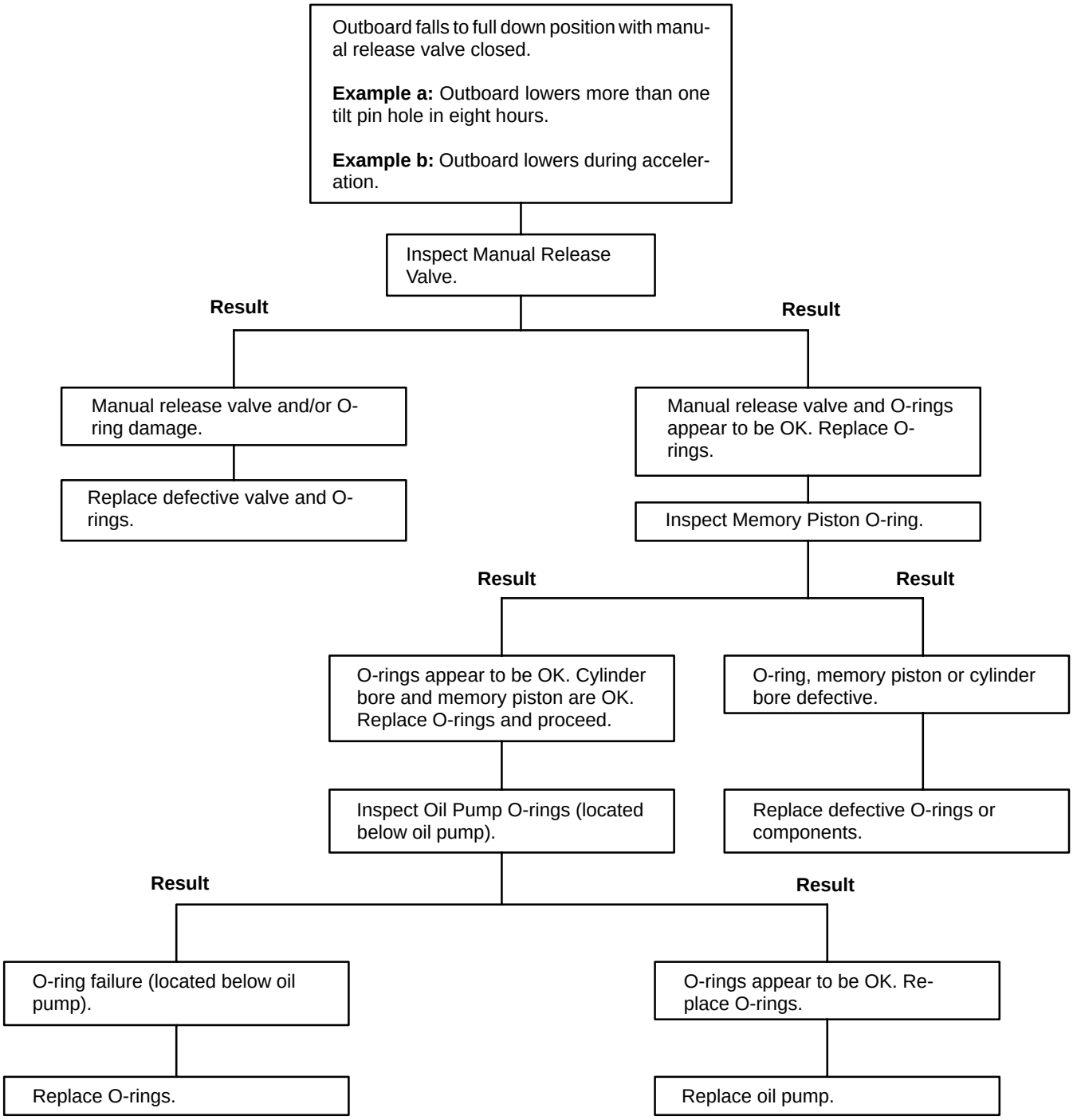
1. Inspect balls and seats in piston assembly for debris or damage. Repair or replace balls/seats.



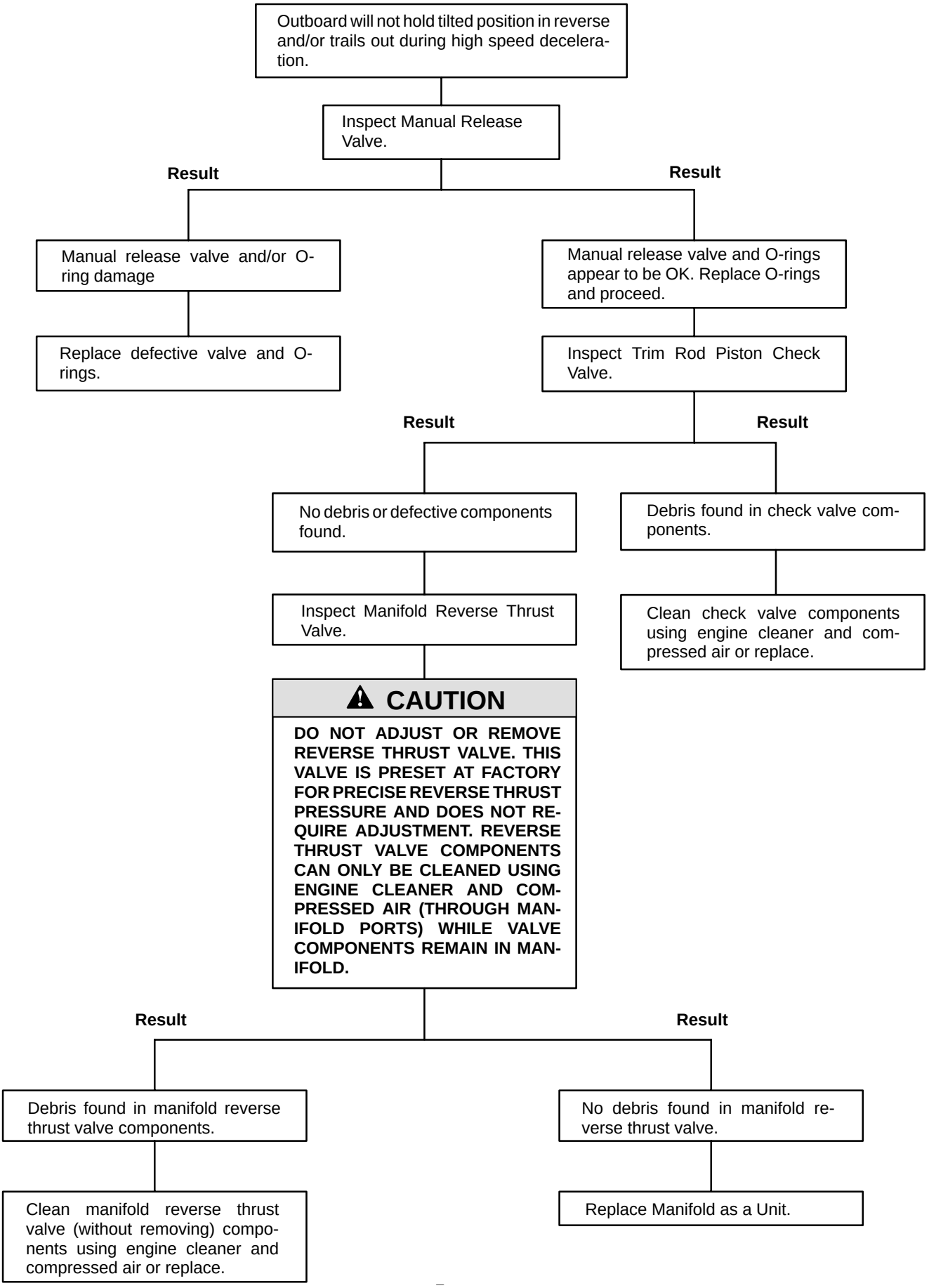
51143

a - Ball and Seat. Check for Debris or Damage

Troubleshooting Flow Diagram

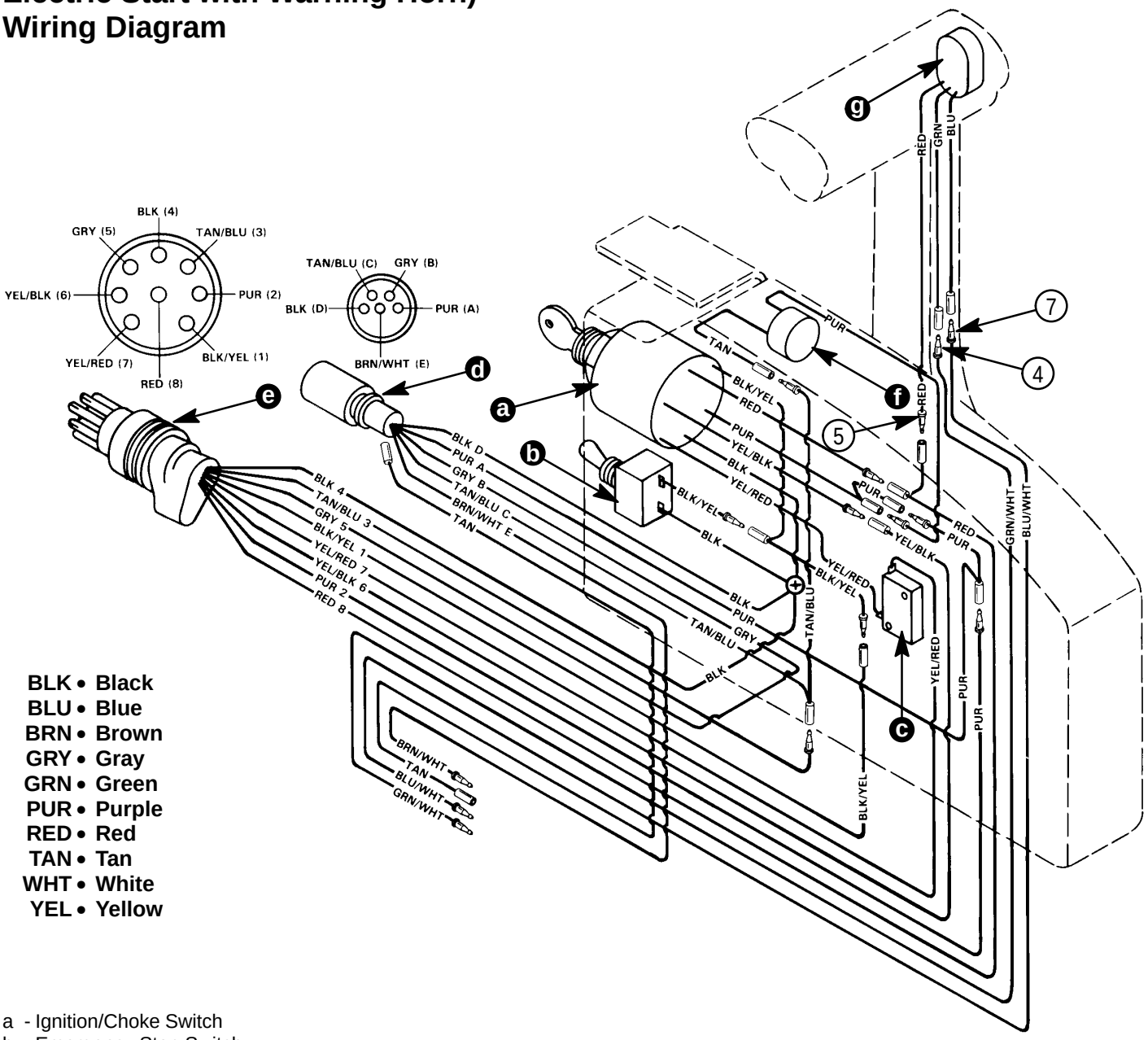

Outboard falls to full down position with manual release valve closed.
Example a: Outboard lowers more than one tilt pin hole in eight hours.
Example b: Outboard lowers during acceleration.
Inspect Manual Release Valve.
Result
Result
Manual release valve and/or O-ring damage.
Replace defective valve and O-rings.
Manual release valve and O-rings appear to be OK. Replace O-rings.
Inspect Memory Piston O-ring.
Result
Result
O-rings appear to be OK. Cylinder bore and memory piston are OK. Replace O-rings and proceed.
Inspect Oil Pump O-rings (located below oil pump).
O-ring, memory piston or cylinder bore defective.
Replace defective O-rings or components.
Result
Result
O-ring failure (located below oil pump).
Replace O-rings.
O-rings appear to be OK. Replace O-rings.
Replace oil pump.

Troubleshooting Flow Diagram


Outboard will not hold tilted position in reverse and/or trails out during high speed deceleration.
Inspect Manual Release Valve.
Result
Result
Manual release valve and/or O-ring damage
Replace defective valve and O-rings.
Manual release valve and O-rings appear to be OK. Replace O-rings and proceed.
Inspect Trim Rod Piston Check Valve.
Result
Result
No debris or defective components found.
Inspect Manifold Reverse Thrust Valve.
Debris found in check valve components.
Clean check valve components using engine cleaner and compressed air or replace.
CAUTION
DO NOT ADJUST OR REMOVE REVERSE THRUST VALVE. THIS VALVE IS PRESET AT FACTORY FOR PRECISE REVERSE THRUST PRESSURE AND DOES NOT REQUIRE ADJUSTMENT. REVERSE THRUST VALVE COMPONENTS CAN ONLY BE CLEANED USING ENGINE CLEANER AND COMPRESSED AIR (THROUGH MANIFOLD PORTS) WHILE VALVE COMPONENTS REMAIN IN MANIFOLD.
Result
Result
Debris found in manifold reverse thrust valve components.
Clean manifold reverse thrust valve (without removing) components using engine cleaner and compressed air or replace.
No debris found in manifold reverse thrust valve.
Replace Manifold as a Unit.

Electrical System Troubleshooting

COMMANDER 2000 Side Mount Remote Control (Power Trim/Tilt Electric Start with Warning Horn) Wiring Diagram

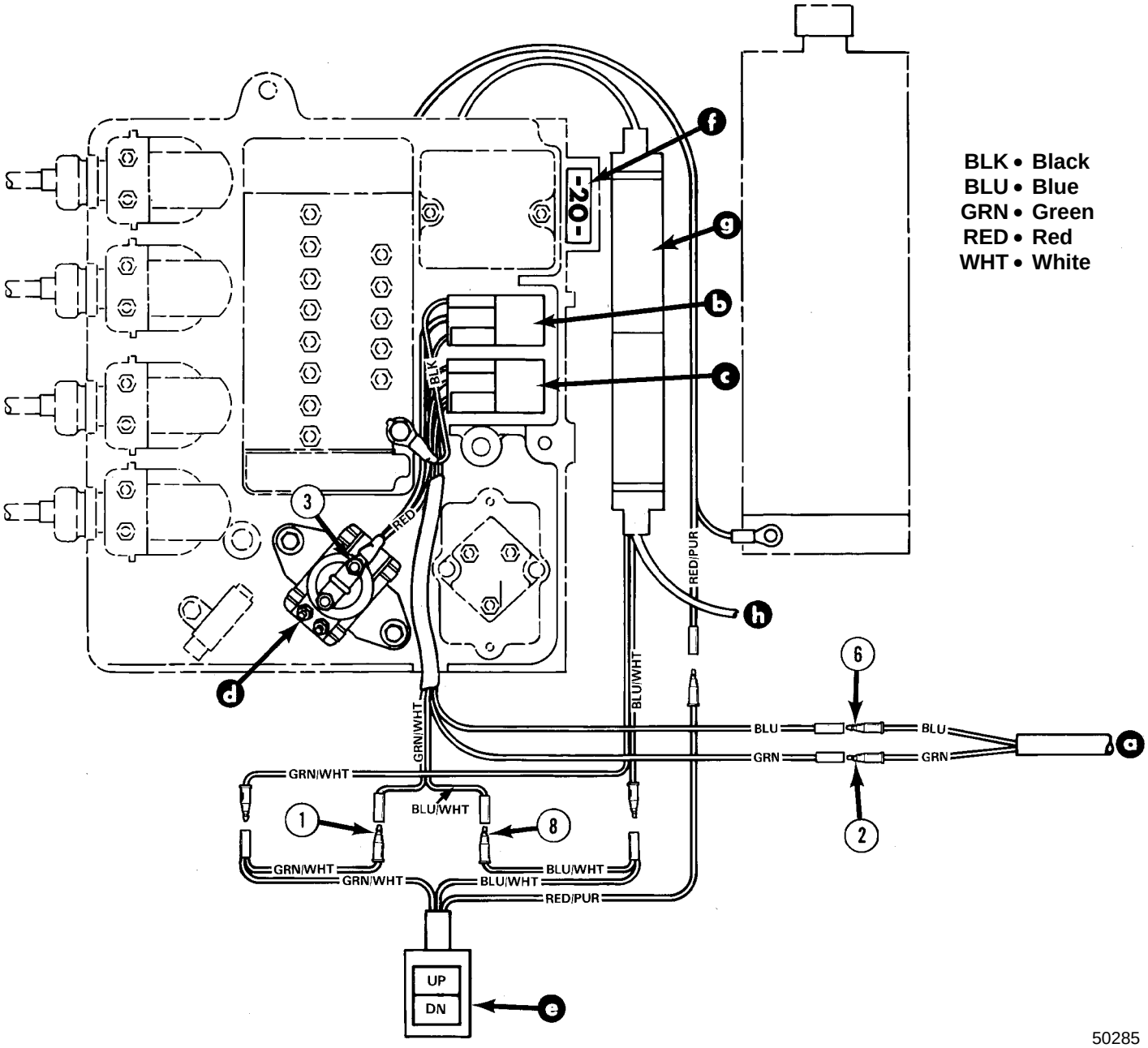


BLK • Black
BLU • Blue
BRN • Brown
GRY • Gray
GRN • Green
PUR • Purple
RED • Red
TAN • Tan
WHT • White
YEL • Yellow

a - Ignition/Choke Switch
b - Emergency Stop Switch
c - Neutral Start Switch
d - Tachometer/Accessories Harness Connector
e - Wiring Harness Connector
f - Warning Horn
g - Trim/Tilt Switch

23891

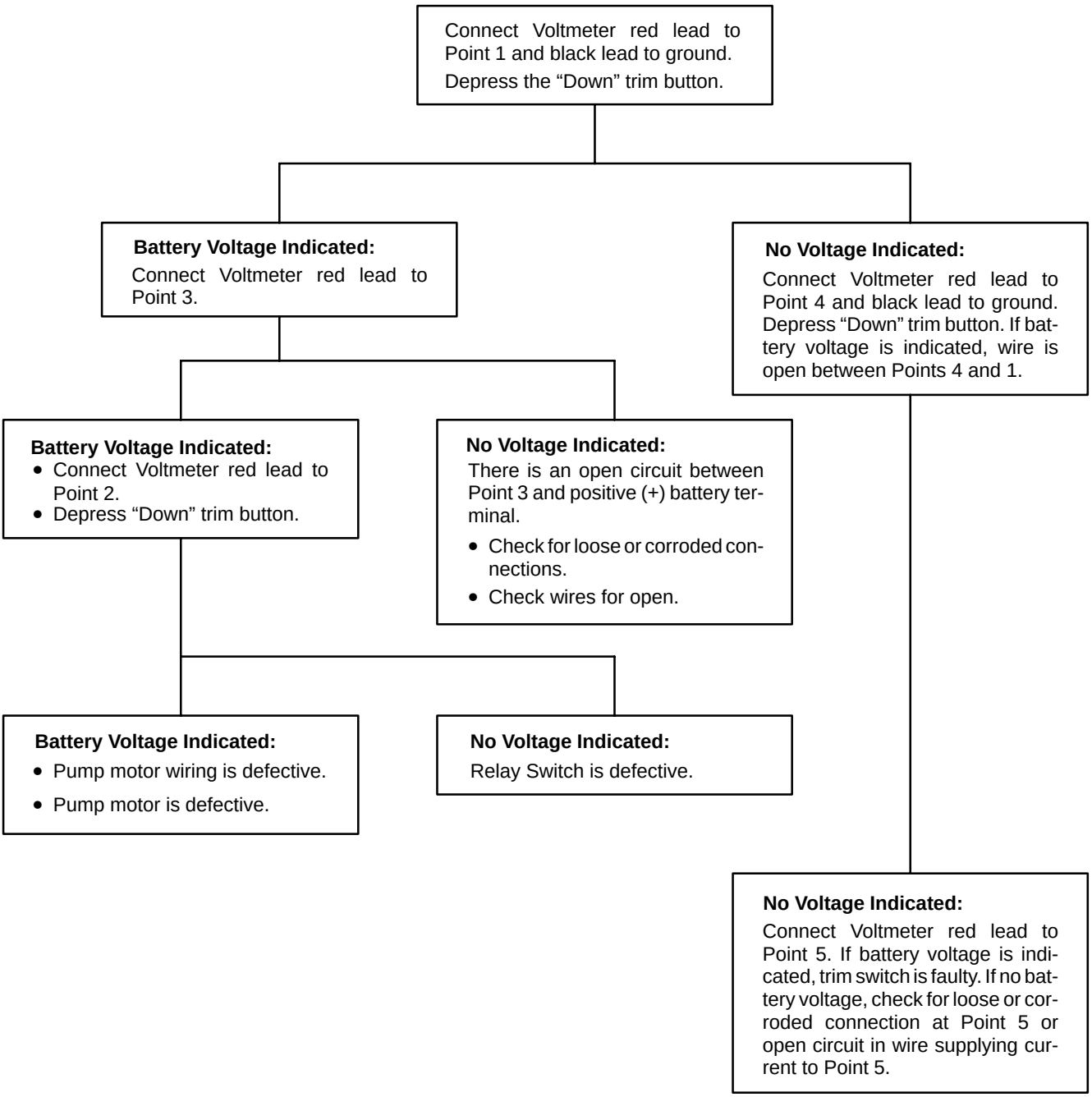
Power Trim System Wiring Diagram



a - To Power Trim Pump Motor
b - Relay Switch “UP”
c - Relay Switch “DOWN”
d - Engine Starter Motor Solenoid
e - Cowl Trim Switch
f - Fuse Holder (20 Amp Fuse)
g - Engine Wiring Harness Connector
h - Remote Control Wiring Harness

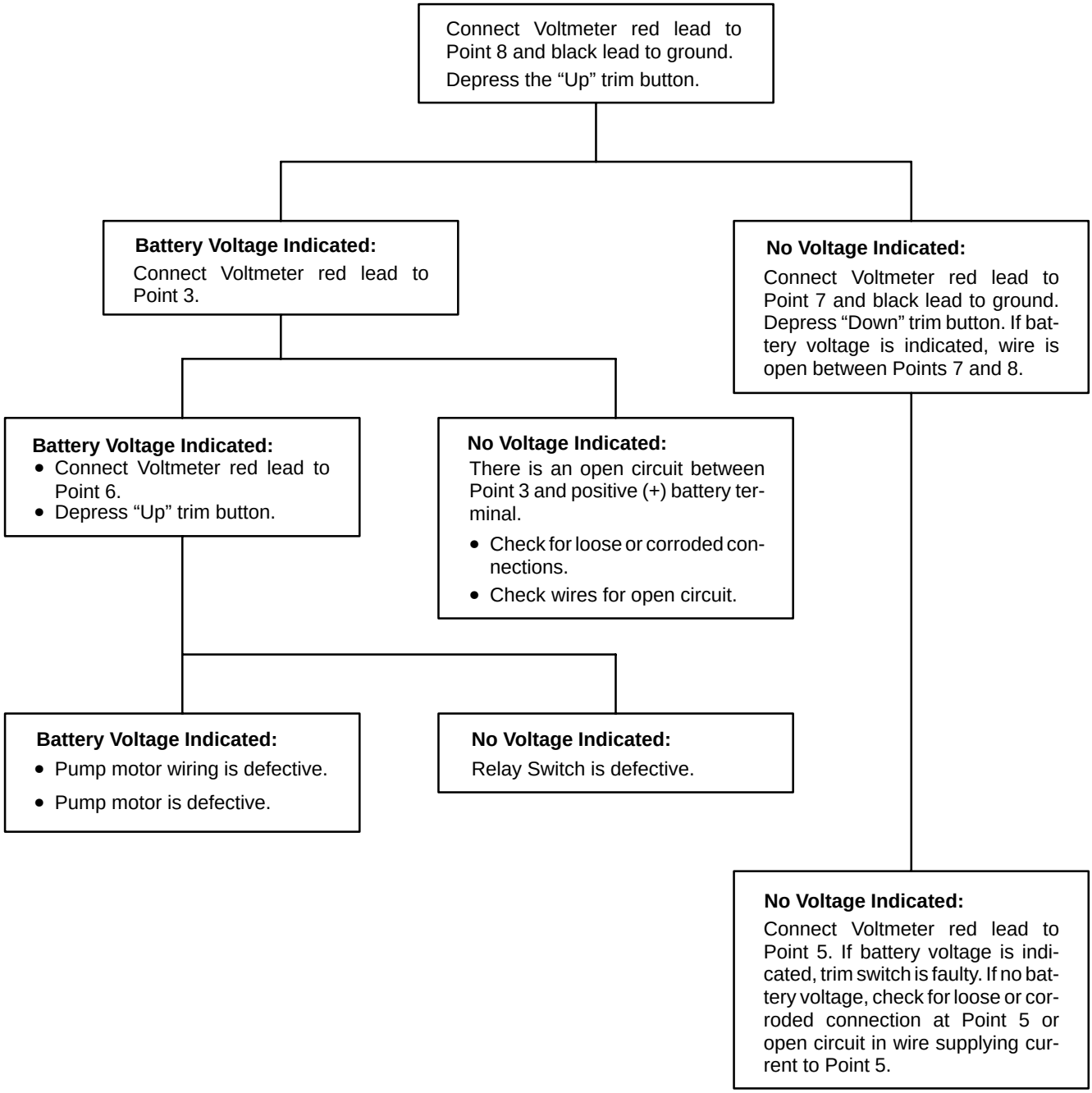
Troubleshooting the “Down” Circuit*
(When “Up” Circuit is OK)

***Remote Control Not Equipped with Trailer Button**


Connect Voltmeter red lead to Point 1 and black lead to ground.
Depress the “Down” trim button.
Battery Voltage Indicated:
Connect Voltmeter red lead to Point 3.
No Voltage Indicated:
Connect Voltmeter red lead to Point 4 and black lead to ground. Depress “Down” trim button. If battery voltage is indicated, wire is open between Points 4 and 1.
Battery Voltage Indicated:
• Connect Voltmeter red lead to Point 2.
• Depress “Down” trim button.
No Voltage Indicated:
There is an open circuit between Point 3 and positive (+) battery terminal.
• Check for loose or corroded connections.
• Check wires for open.
Battery Voltage Indicated:
• Pump motor wiring is defective.
• Pump motor is defective.
No Voltage Indicated:
Relay Switch is defective.
No Voltage Indicated:
Connect Voltmeter red lead to Point 5. If battery voltage is indicated, trim switch is faulty. If no battery voltage, check for loose or corroded connection at Point 5 or open circuit in wire supplying current to Point 5.

Troubleshooting the “Up” Circuit*
(When “Down” Circuit Is OK)

***Remote Control NOT Equipped with Trailer Button**


Connect Voltmeter red lead to Point 8 and black lead to ground.
Depress the “Up” trim button.
Battery Voltage Indicated:
Connect Voltmeter red lead to Point 3.
No Voltage Indicated:
Connect Voltmeter red lead to Point 7 and black lead to ground. Depress “Down” trim button. If battery voltage is indicated, wire is open between Points 7 and 8.
Battery Voltage Indicated:
• Connect Voltmeter red lead to Point 6.
• Depress “Up” trim button.
No Voltage Indicated:
There is an open circuit between Point 3 and positive (+) battery terminal.
• Check for loose or corroded connections.
• Check wires for open circuit.
Battery Voltage Indicated:
• Pump motor wiring is defective.
• Pump motor is defective.
No Voltage Indicated:
Relay Switch is defective.
No Voltage Indicated:
Connect Voltmeter red lead to Point 5. If battery voltage is indicated, trim switch is faulty. If no battery voltage, check for loose or corroded connection at Point 5 or open circuit in wire supplying current to Point 5.

Troubleshooting the “Down” and “Up” Circuits (All Circuits Inoperative)*

***Remote Control Not Equipped with Trailer Button**

Check in-line fuse (under cowl) to see if fuse is blown.

Blown Fuse:
- Correct problem that caused fuse to blow.
- Replace fuse.

Fuse Not Blown:
Connect Voltmeter red lead to Point 3 and black lead to ground. Battery voltage should be indicated.

No Voltage Indicated:
- Check battery leads for poor connections or open circuits.
- Check battery charge.

Battery Voltage Indicated:
- Connect Voltmeter red lead to Point 8 and black lead to ground.
- Depress “Up” trim button and check for battery voltage.

No Voltage Indicated:
Connect red Voltmeter lead to Point 5, and black lead to ground.

Battery Voltage Indicated:
- Check black ground wires for poor connection or poor ground.
- Pump motor is faulty. Refer to “Motor and Electrical Tests/Repair”, following.

No Voltage Indicated:
Check that voltage is being supplied to control by performing the following checks:
- DO NOT start engine.
- Turn ignition switch to “Run” position.
- Check for voltage at any instrument, using a Voltmeter.

Battery Voltage Indicated:
Trim switch is faulty or there is an open circuit in wires (green-white, blue-white) between trim buttons and trim pump.
- Check trim switch.
- Check all trim harness connectors for loose or corroded connections.
- Check for pinched or severed wires.

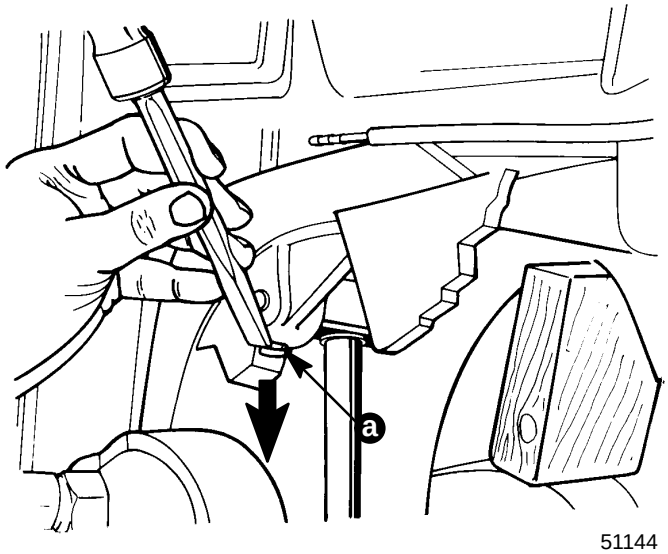
No Voltage Indicated:
Red wire is open between Point 3 and red terminal on back of the ignition switch.
- Check for loose or corroded connections.
- Check for open in wire.

Battery Voltage Indicated:
There is an open circuit in wire between Point 5 and Red terminal on the back of the ignition switch.

Power Trim System Removal

Support outboard with tilt lock lever when servicing power trim system.

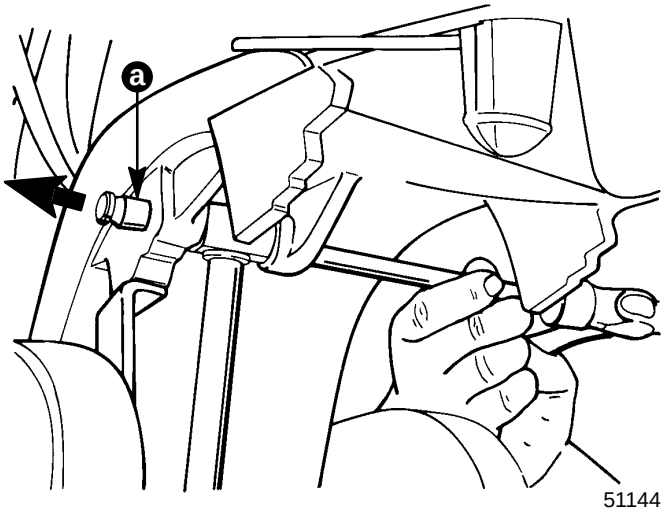
1. Disconnect power trim harness from outboard wiring harness.
2. Remove screw and clip securing wiring harness to clamp bracket.
3. Use suitable tool to remove (DRIVE DOWN) upper dowel pin. Retain dowel pin.



51144

a - Dowel Pin

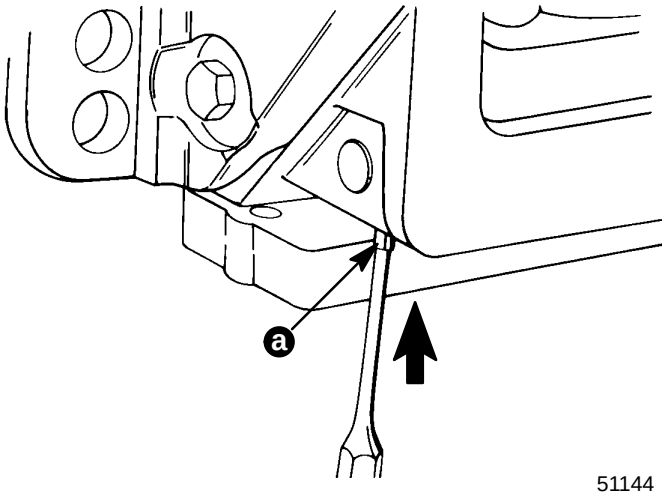
4. Use suitable punch to drive out upper pivot pin.



51144

a - Pivot Pin

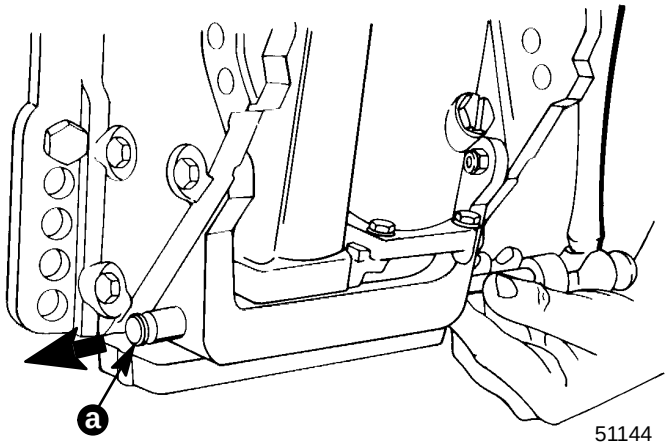
5. Use suitable punch to remove (DRIVE UP) lower dowel pin. Retain dowel pin.



51144

a - Dowel Pin

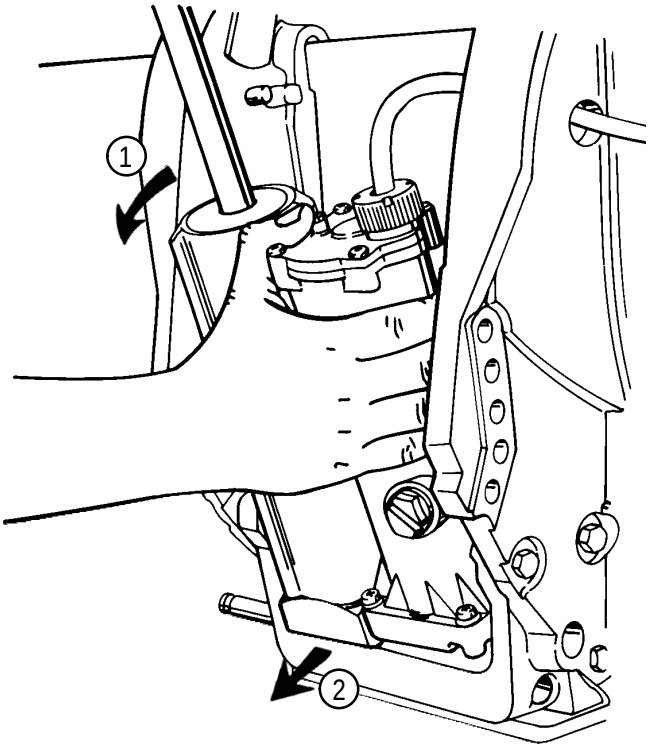
6. Use suitable punch to drive out lower pivot pin.



51144

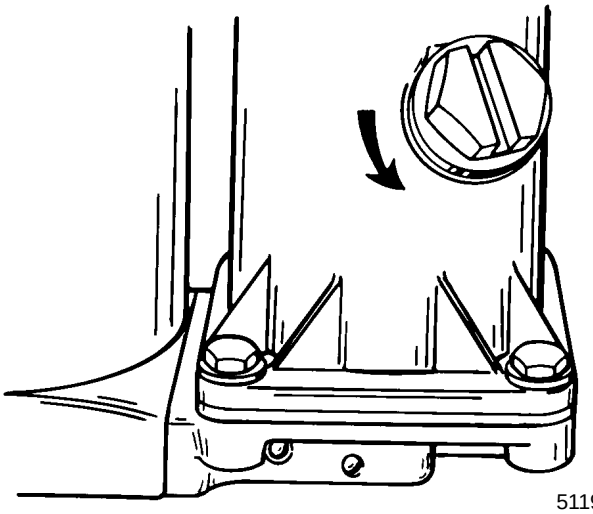
a - Pivot Pin

7. Tilt power trim assembly (top first) out from clamp bracket and remove assembly.



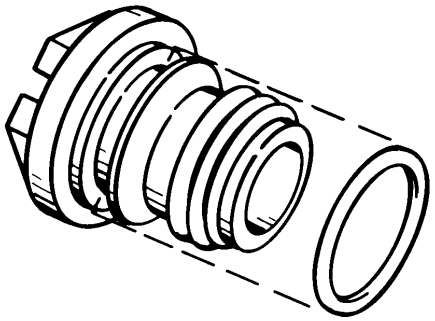
51195

8. Remove fill cap and drain unit.



51193

9. Remove O-ring from fill cap.

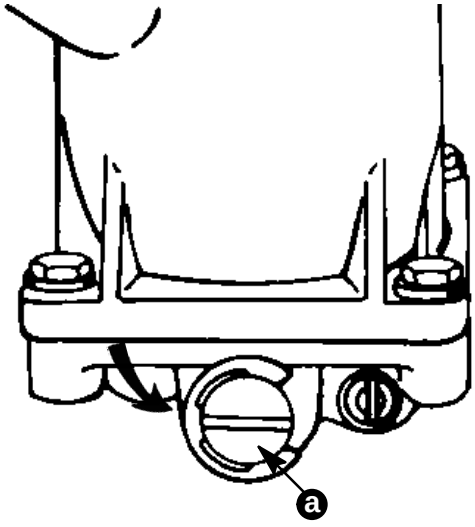


51194

Power Trim System Disassembly

Trim Rod Removal

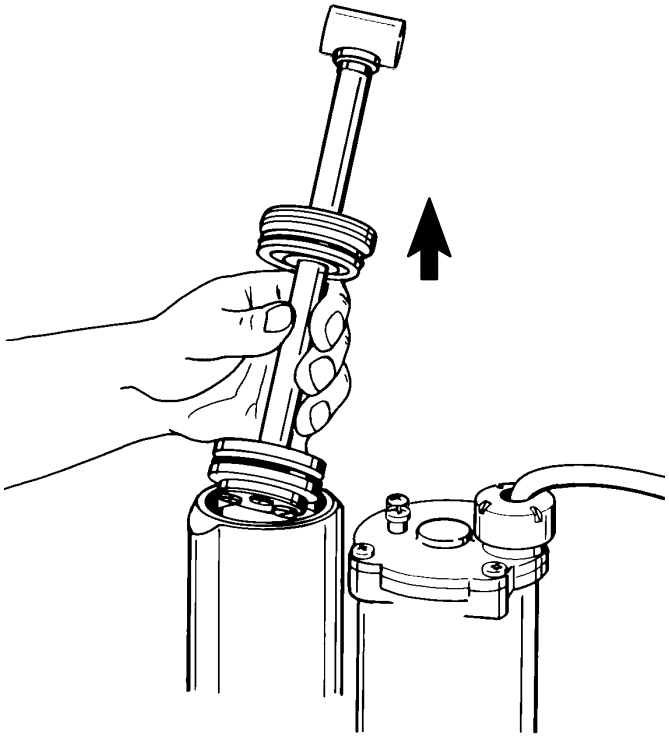
1. Secure power trim assembly in soft jawed vise.
2. Open manual release valve three or four turns (counterclockwise) and position trim rod to full up position.
3. Remove cylinder end cap assembly from cylinder using spanner wrench (1/4 in. x 5/16 in. long pegs).



51194

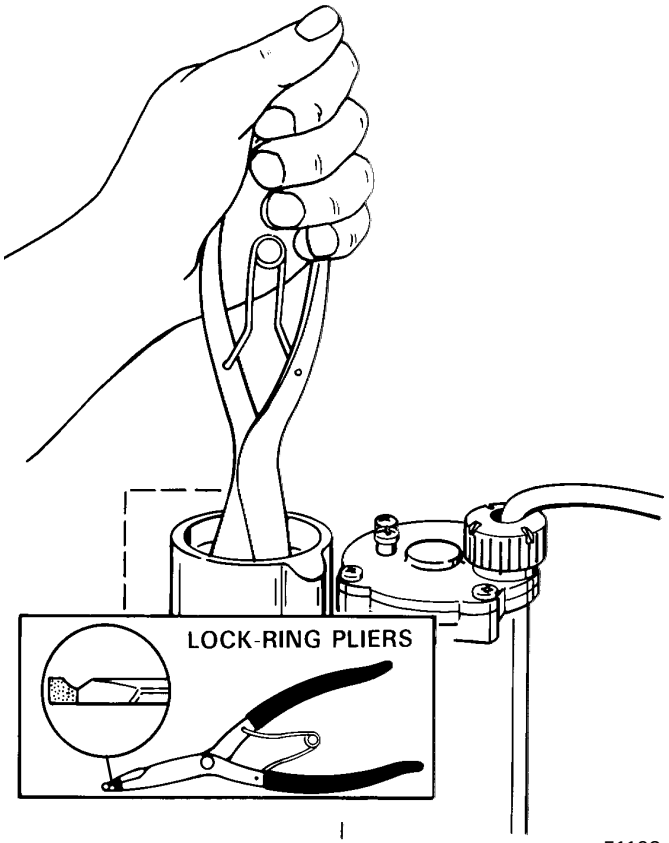
a - Manual Release Valve

4. Remove trim rod assembly from cylinder.



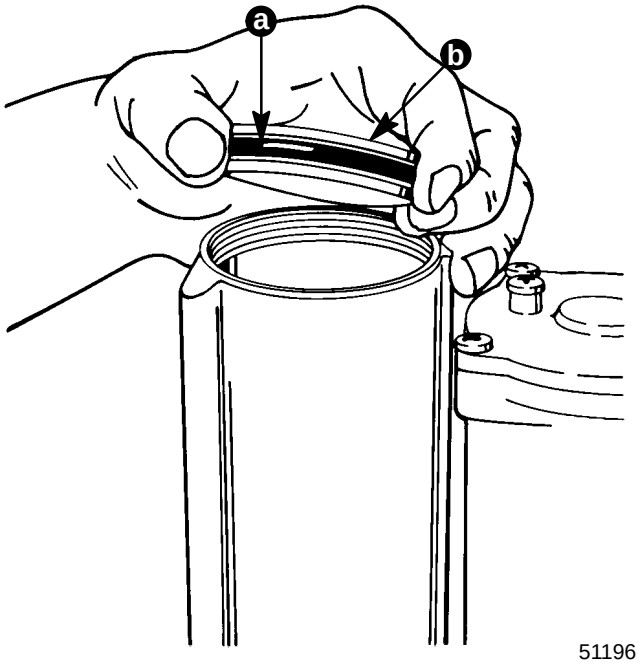
51196

5. Remove memory piston from cylinder using lock-ring pliers (shown) or suitable tool.



51193

6. Remove O-ring from memory piston.



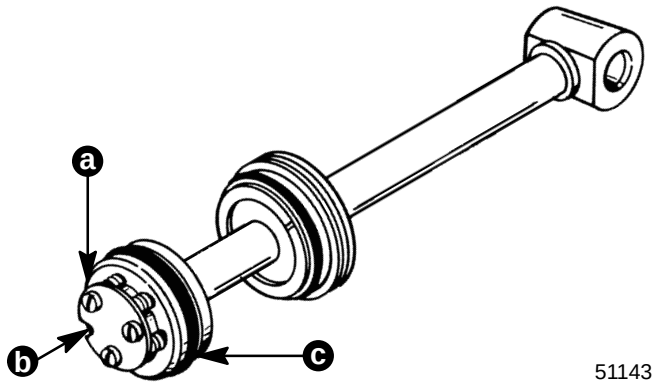
51196

a - O-ring
b - Memory Piston

7. Remove trim system from vise and empty fluid into appropriate container.

Trim Rod Disassembly

1. Place trim rod assembly on clean work surface.
2. Remove screws securing plate to trim rod piston and O-ring.
3. Remove check ball components from trim rod piston.



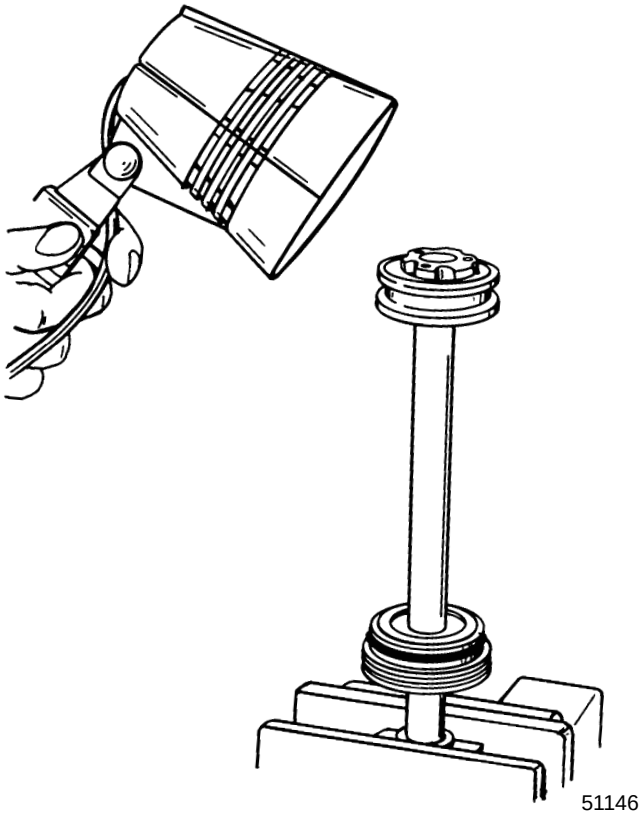
51143

a - Screw
b - Plate
c - O-ring

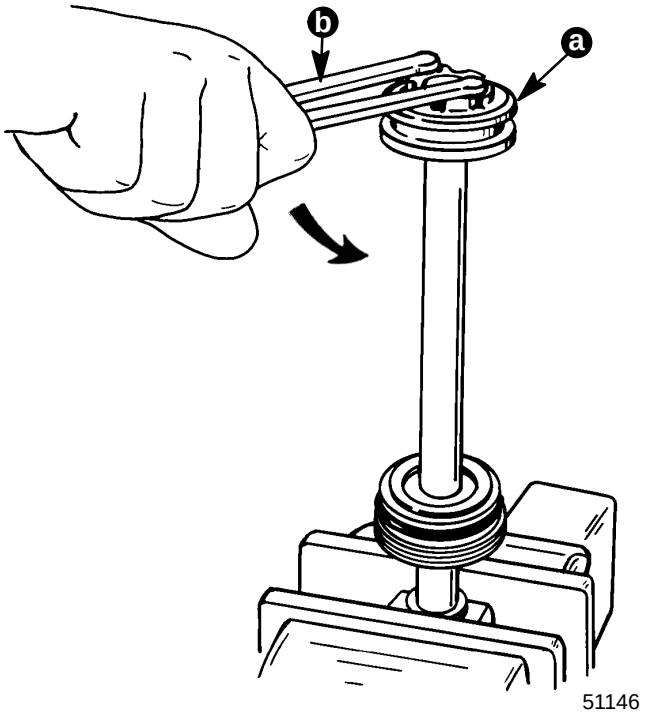
⚠ CAUTION

When removing Trim Rod piston, spanner wrench must have 1/4 in. x 5/16 in. long pegs to avoid damage to trim piston.

4. Place trim rod into soft jawed vise and apply heat to shock piston using torch lamp (P/N 91-63209).
5. Loosen trim rod piston using spanner wrench (1/4 in. x 5/16 in. long pegs).
6. Allow trim rod piston to cool, remove from trim rod.



51146



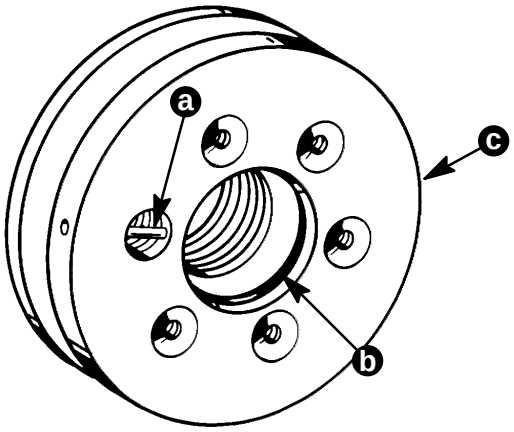
51146

a - Trim Rod Piston
b - Spanner Wrench

⚠ CAUTION

Do not remove check ball components from trim rod piston. Removal and reinstallation of check valve could result in improper operating pressure and possible power trim system damage. If check valve is defective, replace trim rod piston.

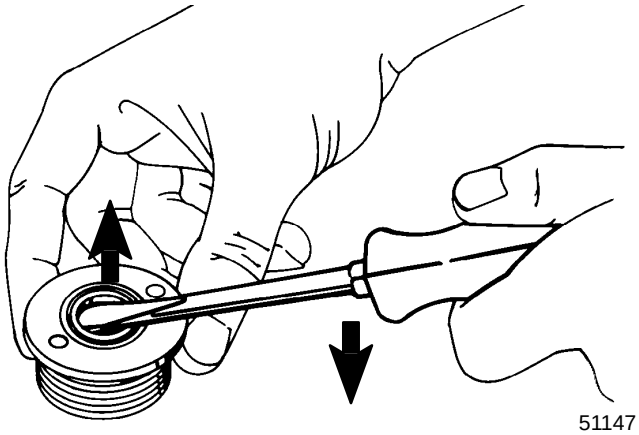
7. Remove inner O-ring from piston.



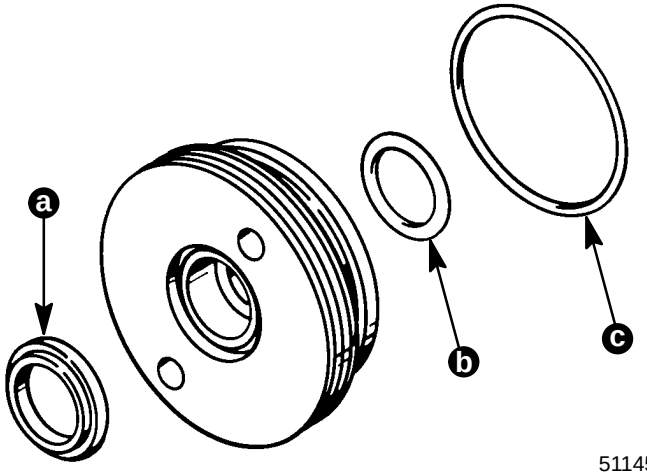
51199

a - Check Ball Components
b - O-ring
c - Piston

8. Remove rod wiper, inner O-ring and outer O-ring.



51147

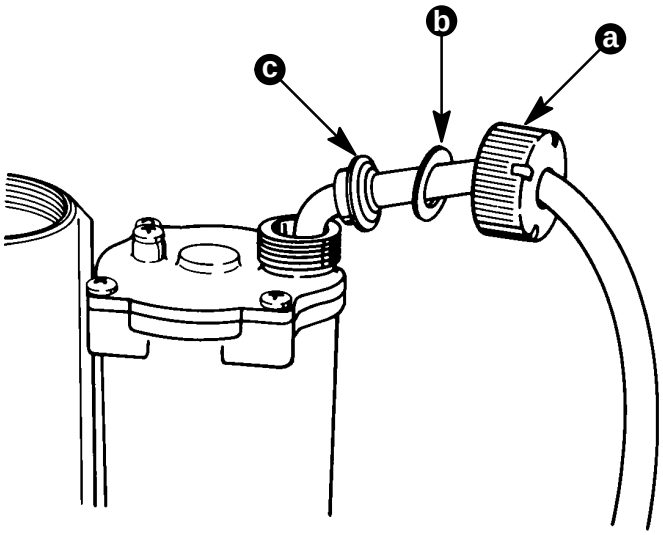


51145

a - Rod Wiper
b - Inner O-ring
c - Outer O-ring

Trim “Motor” Removal

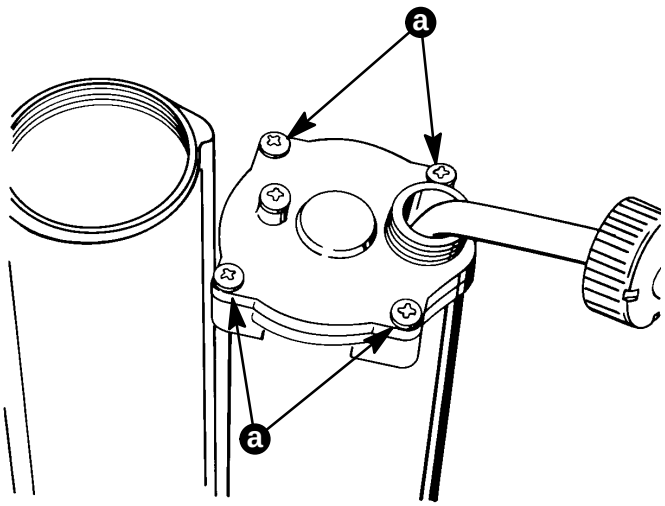
1. Secure power trim assembly in soft jawed vise.
2. Remove cap, washer and grommet from reservoir assembly.



51195

a - Cap
b - Washer
c - Grommet

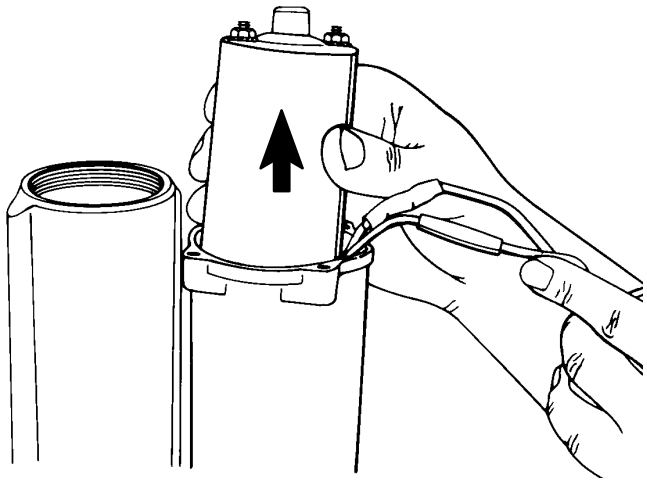
3. Remove screws securing reservoir cap to reservoir.



51193

a - Screws

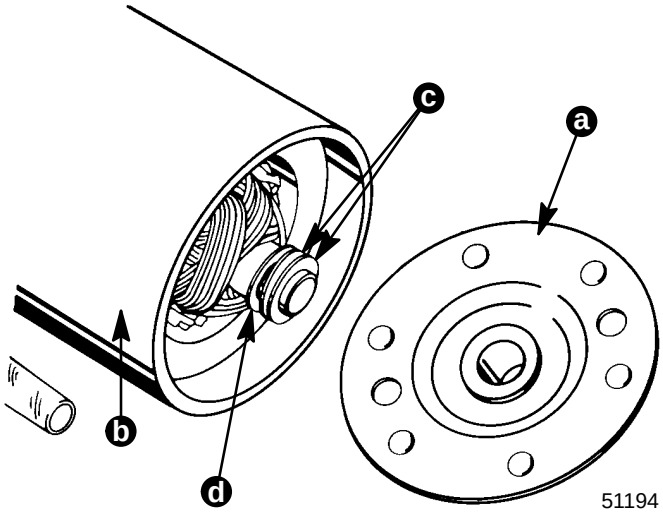
4. Remove motor and harness from reservoir.



51196

Trim “Motor” Disassembly

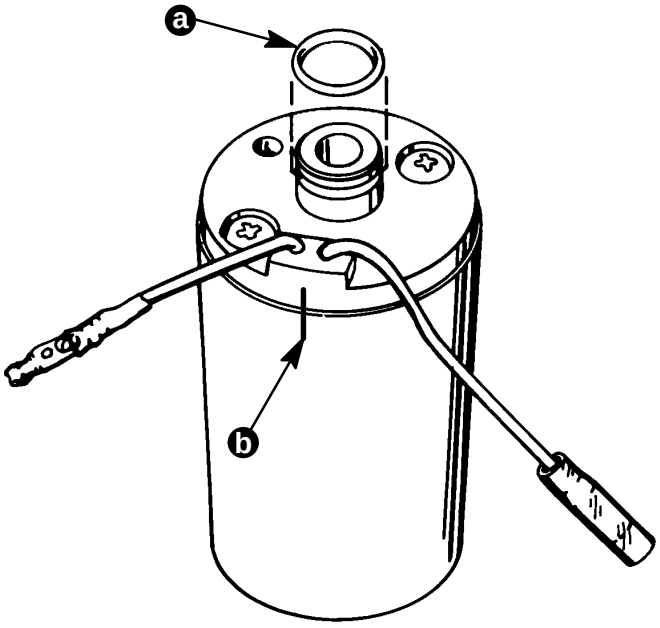
1. Remove end cap from motor housing. Note position of washers on armature.



51194

a - End Cap
b - Motor Housing
c - Wave Washer (2)
d - Washer

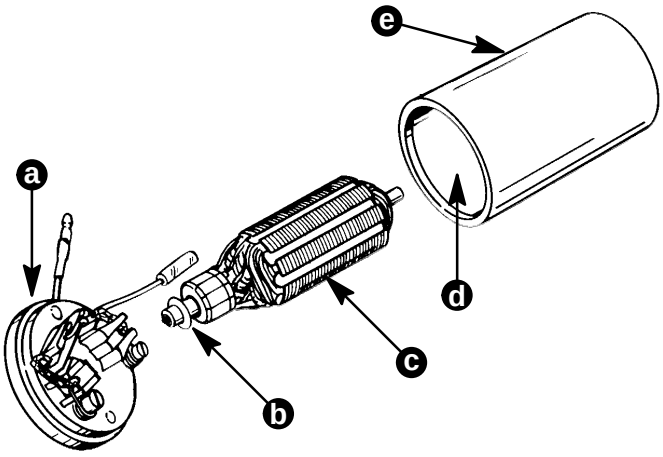
2. Remove O-ring from end frame.
3. Place scribe mark on motor housing and end frame as reassembly reference, as shown.



51194

a - O-ring
b - Scribe Mark

4. Remove end frame and armature from housing.



51194

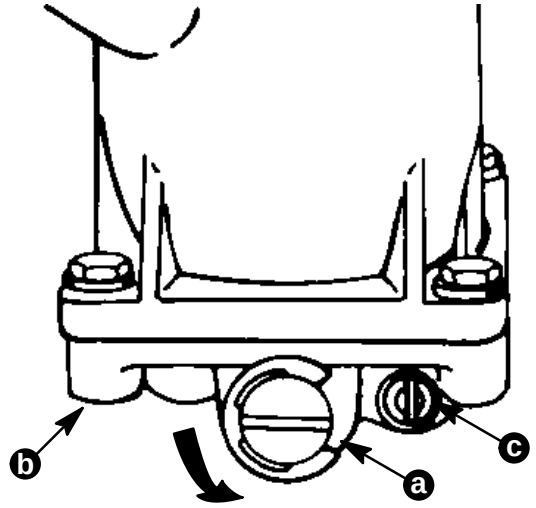
a - End Frame
b - Washer
c - Armature
d - Fiber Guard (Brush Wires)
e - Housing

Reservoir Assembly Removal

⚠ CAUTION

DO NOT ADJUST OR REMOVE REVERSE THRUST VALVE. THIS VALVE IS PRESET AT FACTORY FOR PRECISE REVERSE THRUST PRESSURE AND DOES NOT REQUIRE ADJUSTMENT.

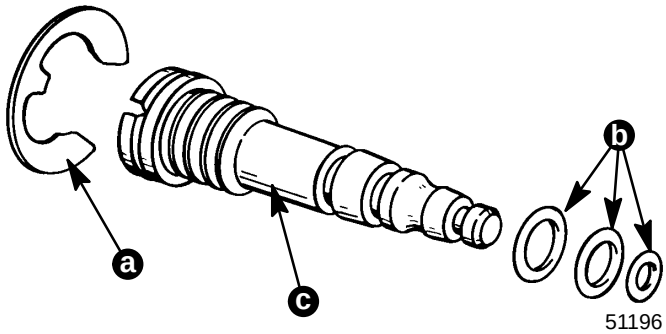
1. Remove manual release valve from manifold. **DO NOT** remove or adjust reverse thrust valve.



51194

a - Manual Release Valve
b - Manifold
c - Reverse Thrust Valve

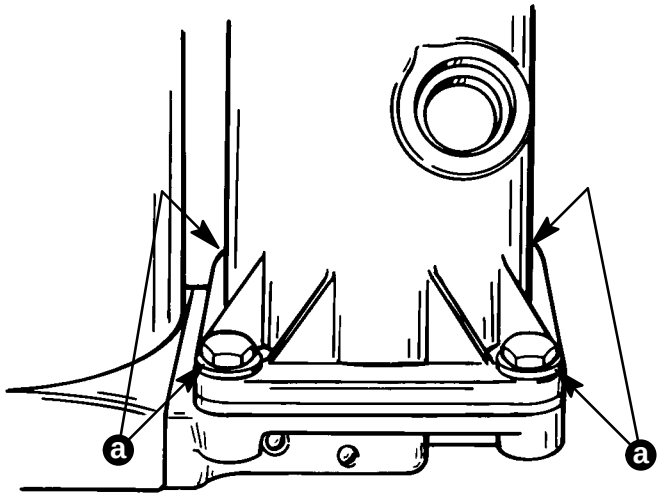
2. Remove “E” clip and O-rings from manual release valve.



51196

a - “E” Clip
b - O-rings
c - Manual Release Valve

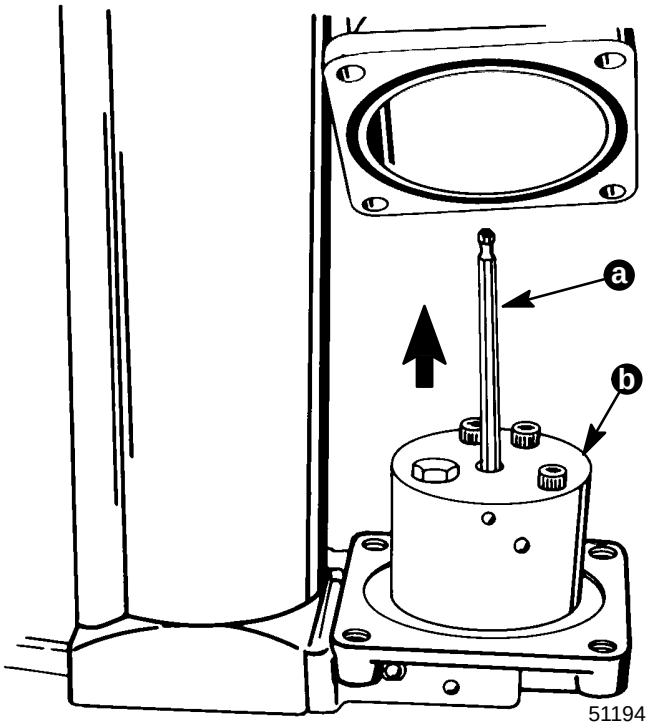
3. Remove four screws securing reservoir to manifold.



51193

a - Screw

4. Remove reservoir from manifold.
5. Remove drive shaft from oil pump.



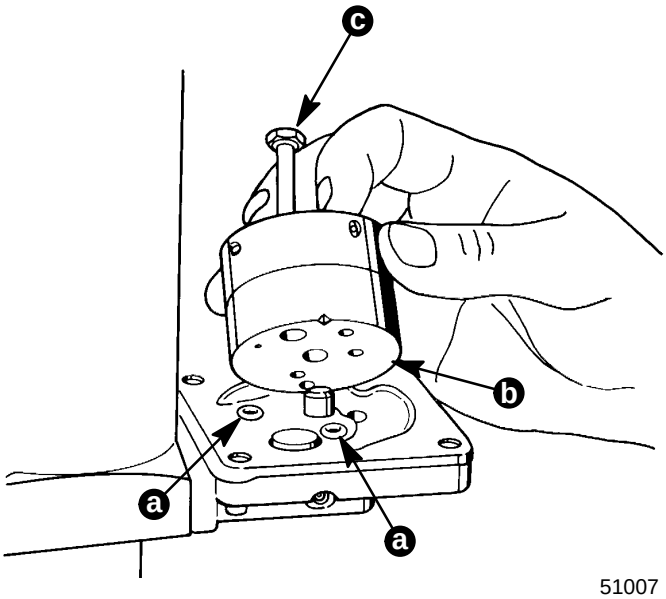
51194

a - Drive Shaft
b - Oil Pump

Oil Pump Removal

IMPORTANT: The oil pump is not rebuildable. If oil pump is defective, replace as an assembly.

1. Remove screw, oil pump and O-rings from manifold.

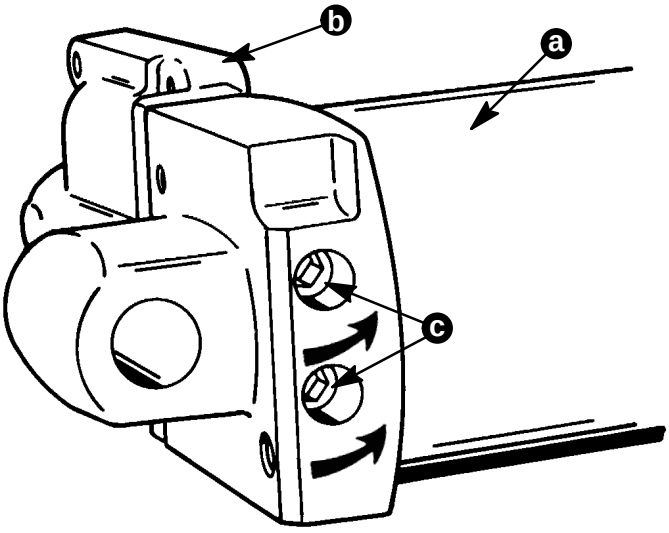


51007

a - O-ring
b - Oil Pump
c - Screw

Manifold Removal

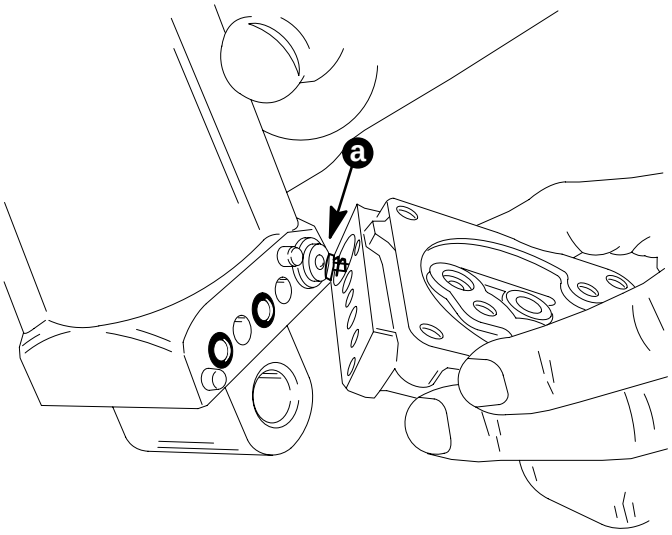
1. While holding trim cylinder to manifold, remove screws.



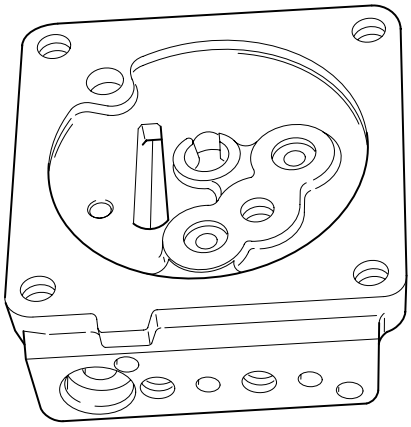
51007

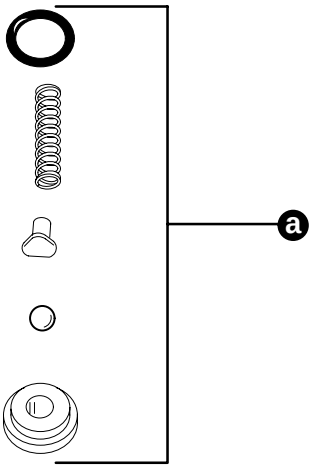
a - Trim Cylinder
b - Manifold
c - Screw

2. Slowly remove manifold from cylinder. Note position of above trim check ball assembly and remove.



54743

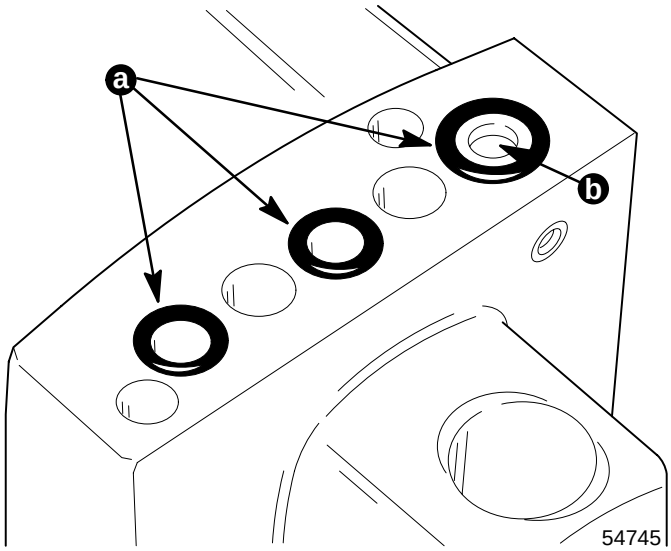




54744

a - Above Trim Check Ball Components

3. Remove O-rings from cylinder.
4. Remove filter.



54745

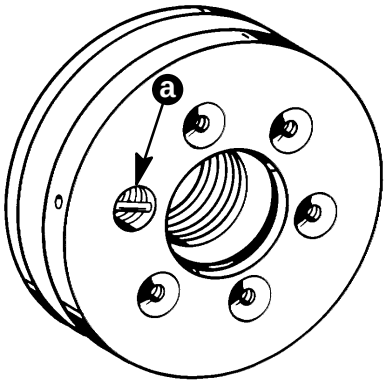
a - O-rings
b - Filter

Cleaning and Inspection of Trim Rod Components

IMPORTANT: Components must be dirt and lint free. Slightest amount of debris in Power Trim system could cause system to malfunction.

⚠ CAUTION

Do not remove check valve components from trim rod piston. Removal and reinstallation of check valve could result in improper operating pressure and possible power trim system damage.



51199

a - Check Ball Components

Inspect check valve for debris; clean debris from check valve if found. If debris cannot be cleaned from check valve, replace trim rod piston as an assembly.

Clean trim rod and components with parts cleaner and dry with compressed air.

It is recommended that all O-rings in trim system be replaced.

Inspect trim rod. If scraper (located in cap) has failed to keep rod clean, replace scraper.

Lubricate all O-rings using Quicksilver Power Trim and Steering Fluid or; (ATF) Type F, FA or Dexron II.

Motor and Electrical Tests/ Repair

Trim Pump Motor Test

⚠ WARNING

Do not perform this test near flammables (or explosives), as a spark may occur when making connections.

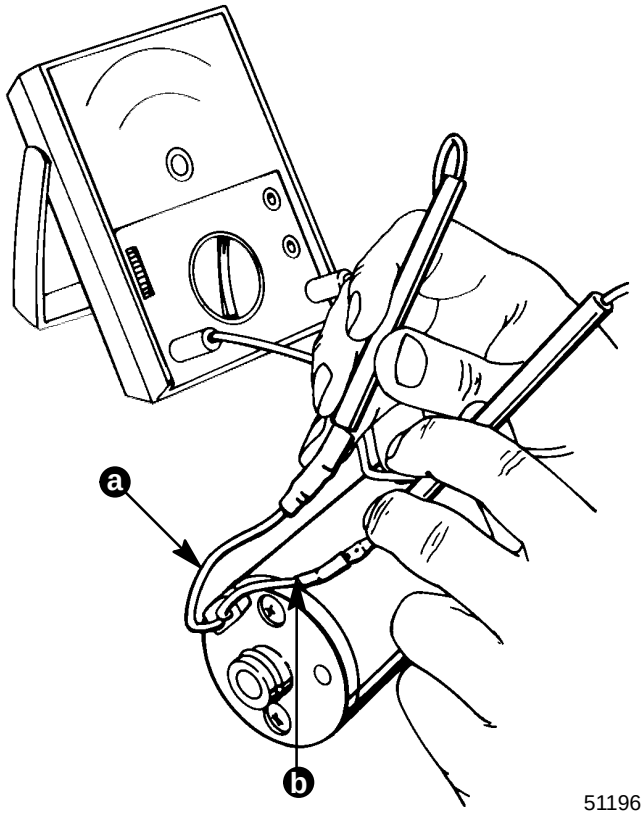
1. Disconnect orange (motor) wire and black (motor) wire from relay switch wiring harness.
2. Connect a 12 volt power supply to motor wires (positive to orange; negative to black results in motor up direction. Positive to black; negative to orange results in motor down direction). Motor should run.
3. If motor does not run, disassemble motor and check components.

Thermal Overload Switch Test

IMPORTANT: If thermal overload switch has been activated, pump motor cannot be tested for a minimum of one minute. After this period switch should close (reset itself) and pump motor may be operated. Perform the following check(s) only if switch does not reset itself.

MOTOR ASSEMBLED

Connect Ohmmeter (R x 1 scale) leads as shown. If switch is good, full continuity (zero ohms) will be indicated. If full continuity is not indicated, disassemble motor and recheck switch per instructions, following.

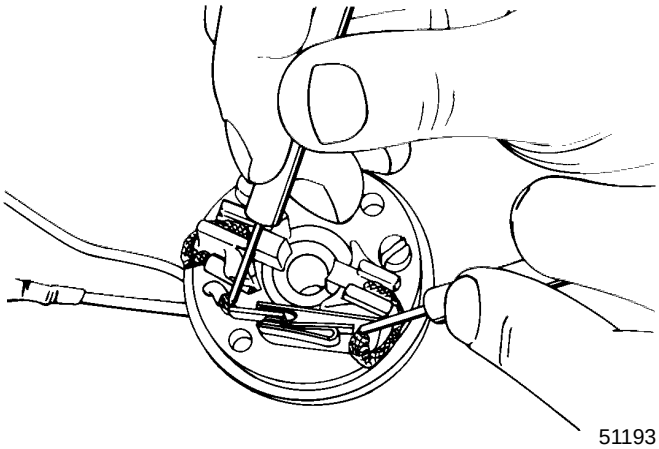


51196

a - Motor Wire (Black)
b - Motor Wire (Orange)

MOTOR DISASSEMBLED

Connect Ohmmeter (R x 1 scale) leads as shown. If switch is good, full continuity (zero ohms) will be indicated.



51193

If full continuity is not indicated, clean switch contact surfaces, using an ignition point file.

Recheck switch; if full continuity is not indicated, replace end frame.

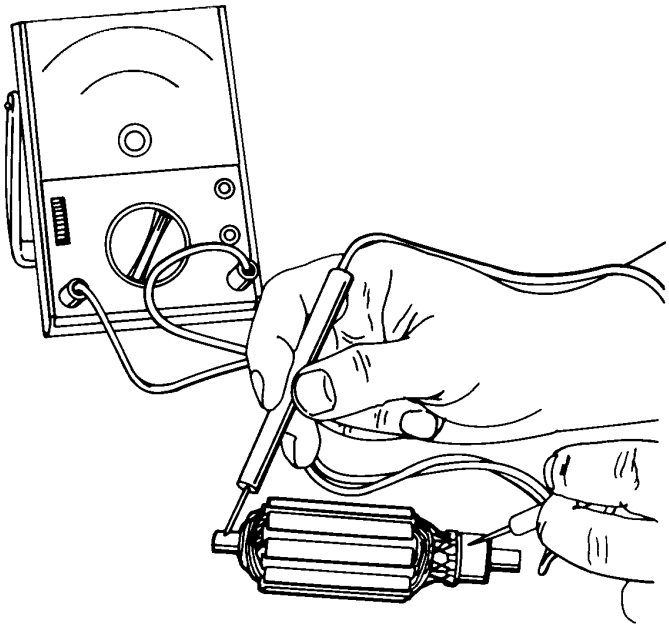
Armature Tests

TEST FOR SHORTS

Check armature on a Growler (follow Growler manufacturer's test instructions). Indication of a short requires replacement of armature.

TEST FOR GROUND

Use an Ohmmeter (R x 1 scale). Place one lead of Ohmmeter on armature shaft and other lead on commutator, as shown. If continuity is indicated, armature is grounded and must be replaced.

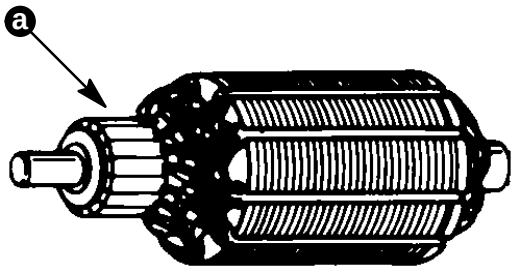


51195

CHECKING AND CLEANING COMMUTATOR

If commutator (a) is worn it can be turned down on an armature conditioner tool or on a lathe.

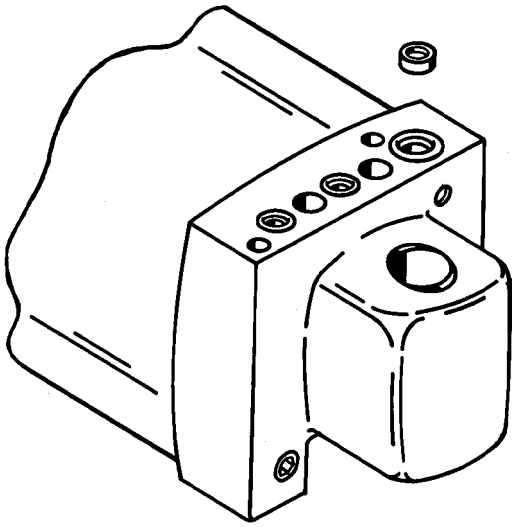
Clean commutator with "00" sandpaper.



Power Trim System Reassembly

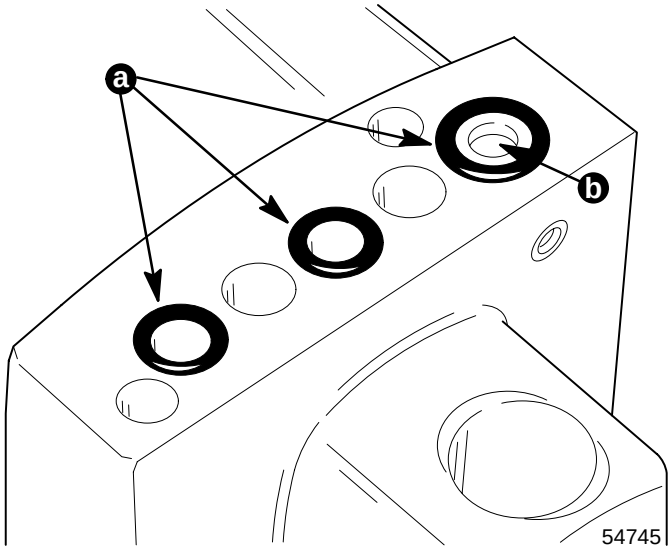
Manifold Installation

IMPORTANT: Filter must be installed in trim cylinder with ridge of filter housing facing out.



50447

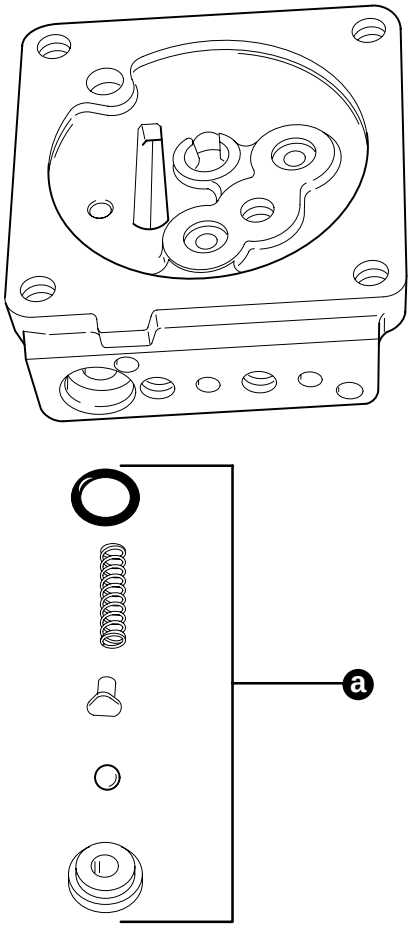
1. Install lubricated O-rings and filter, with housing ridge facing out, to trim cylinder.



54745

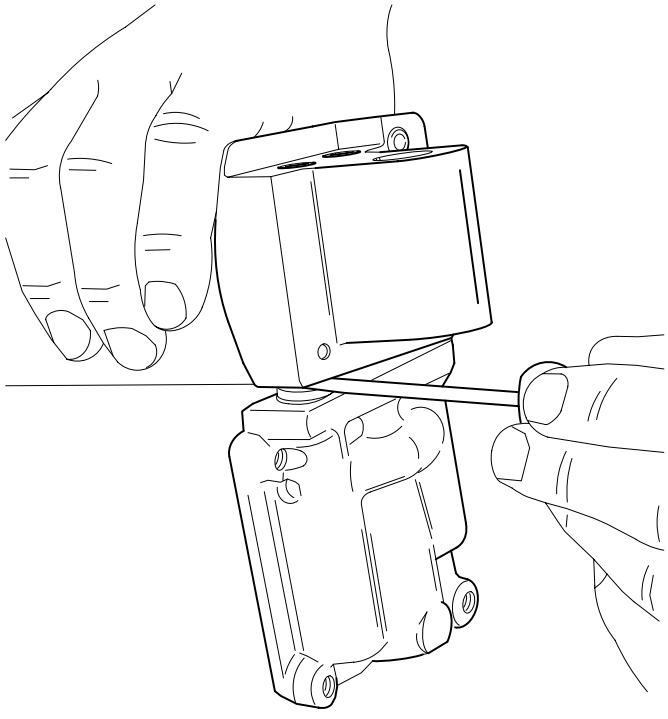
a - O-ring
b - Filter

2. Install check ball components (a) into manifold.



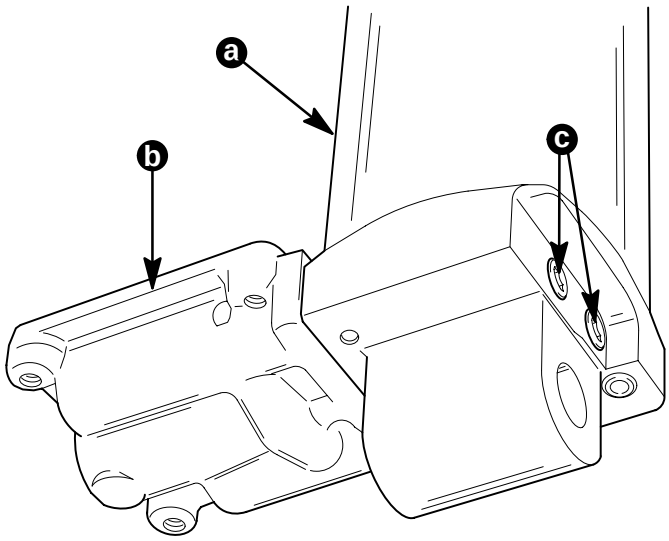
54744

3. Hold check ball components in place using screwdriver (as shown). Connect manifold to trim cylinder.



54748

4. Secure manifold to cylinder using screws, torque to 100 lb. in. (11.2 N·m).

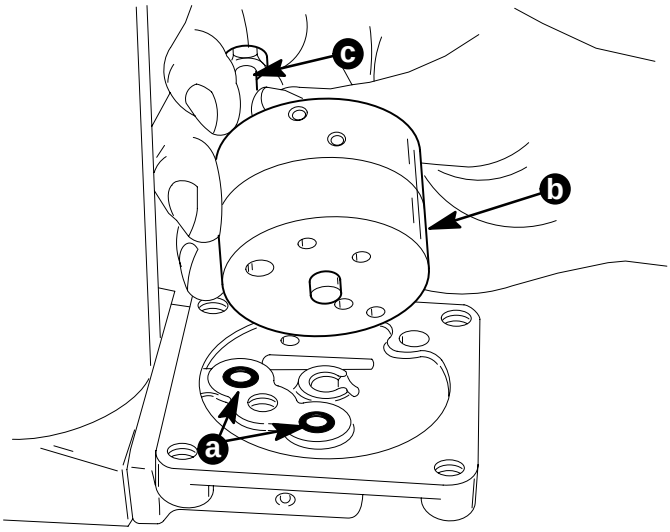


54746

a - Trim Cylinder
b - Manifold
c - Screw

Oil Pump Installation

1. Secure power trim unit in soft jawed vise.
2. Install lubricated O-rings to manifold.
3. Install oil pump to manifold and secure using screw, torque to 90 lb. in. (10.2 N·m).

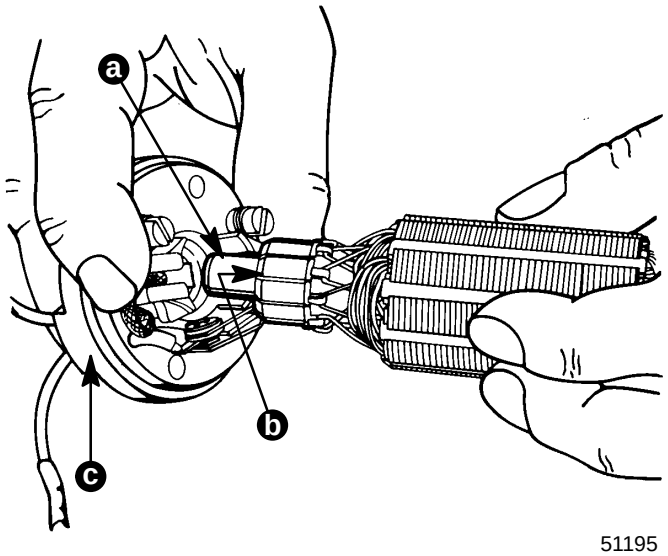


54747

a - O-ring
b - Oil Pump
c - Screw

Trim Motor Reassembly

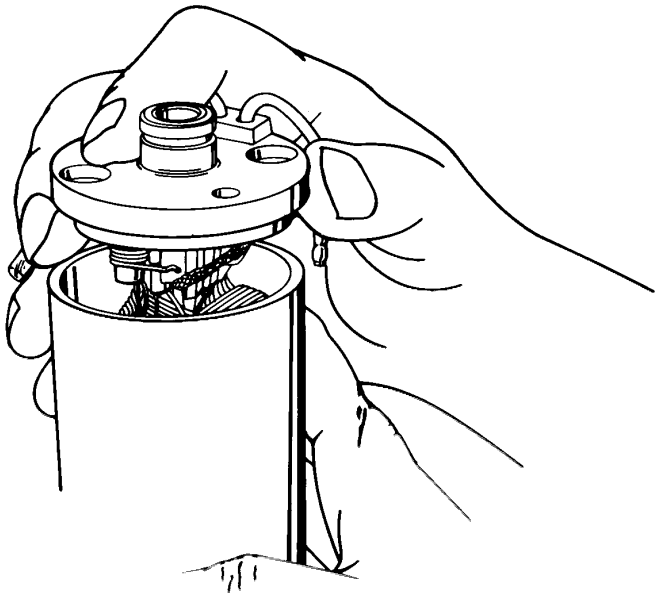
1. Apply Quicksilver Marine Lubricant (2-4-C) to armature shaft and insert into end frame.



51195

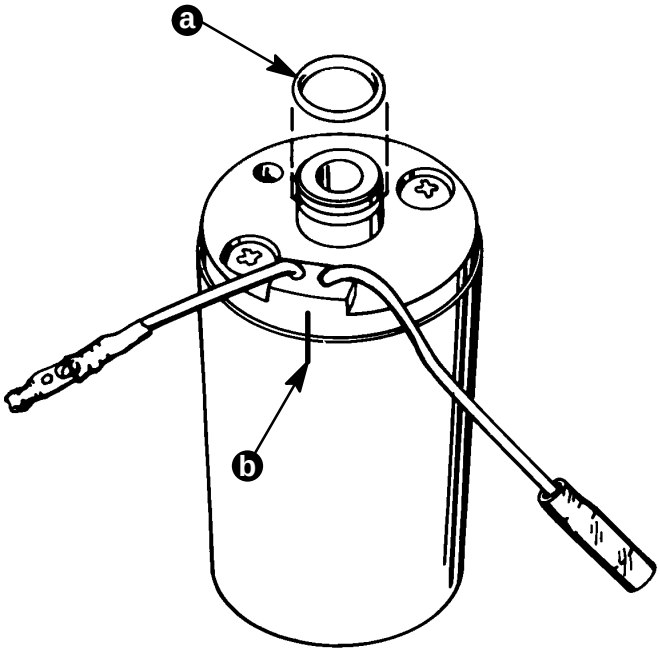
a - Armature Shaft
b - Washer
c - End Frame

2. Guide armature and end frame into housing as shown.



51196

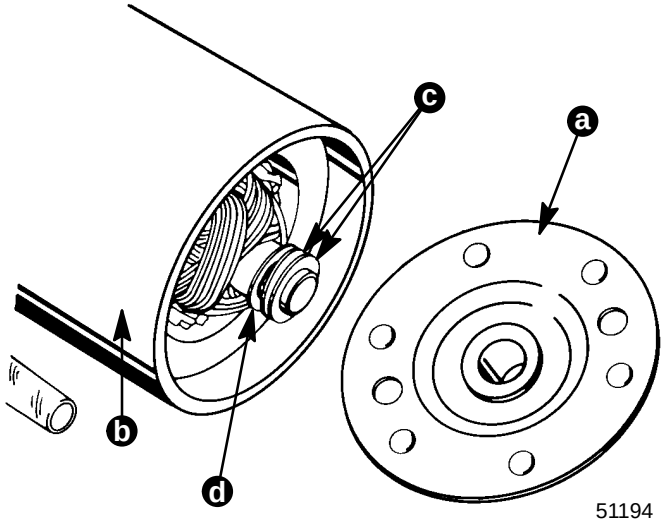
3. Align scribe mark on housing with mark on end frame.
4. Install lubricated O-ring to end frame.



51194

a - O-ring
b - Scribe Mark

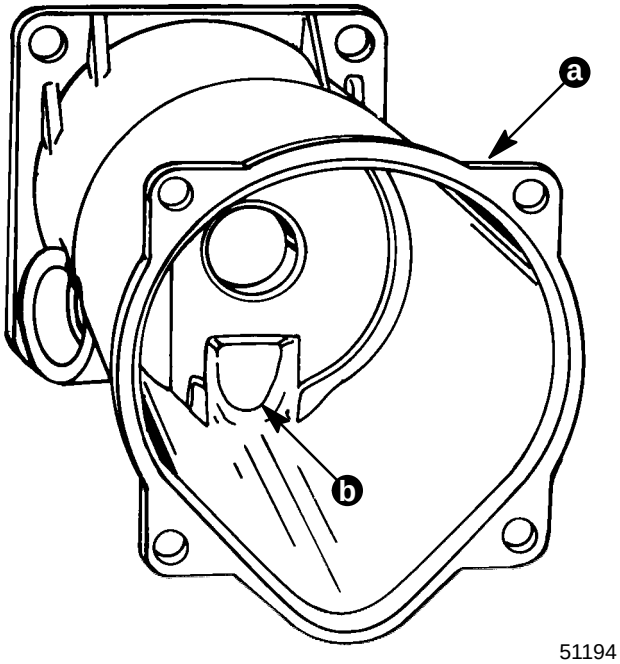
5. Install washers to armature shaft as shown.
6. Install end cap to housing. Torque nuts to 25 lb. in. (2.8 N·m).



51194

a - End Cap
b - Motor Housing
c - Wave Washer
d - Washer

IMPORTANT: When installing motor, wires (black, orange) must rest in cavity of cylinder allowing motor to seat properly.

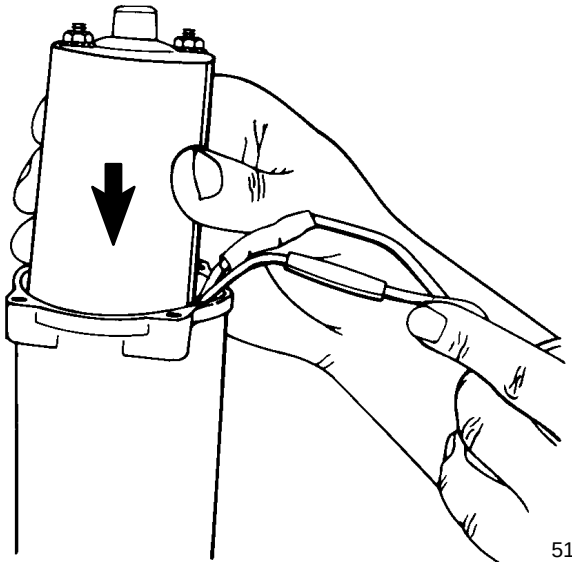


51194

a - Manifold
b - Cavity

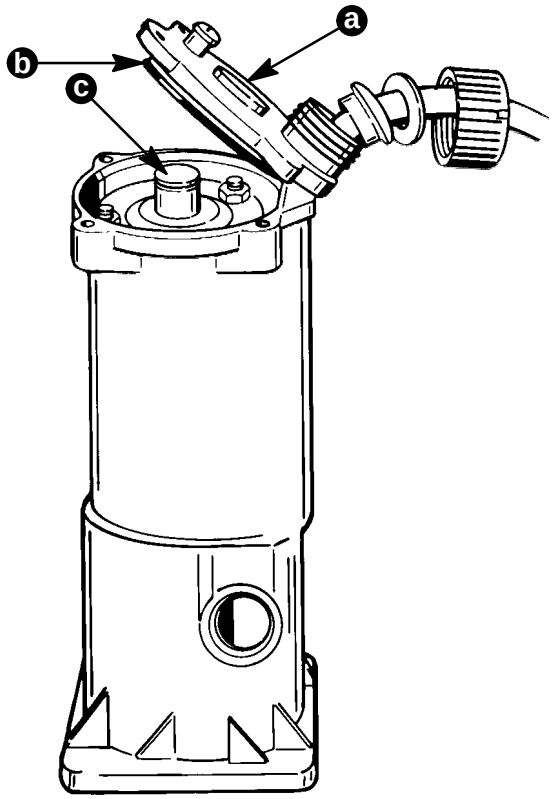
Reservoir Installation

1. Connect trim motor wires to harness.
2. Insert motor into reservoir. Motor must be seated properly prior to end cap installation.



51196

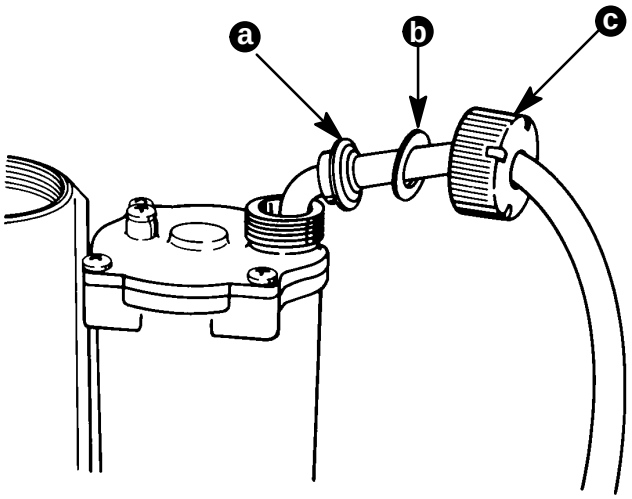
3. Install end cap, O-ring and foam pad to cylinder.
4. Torque screws to 13 lb. ft. (1.5 N·m).



51195

a - End Cap
b - O-ring
c - Foam Pad

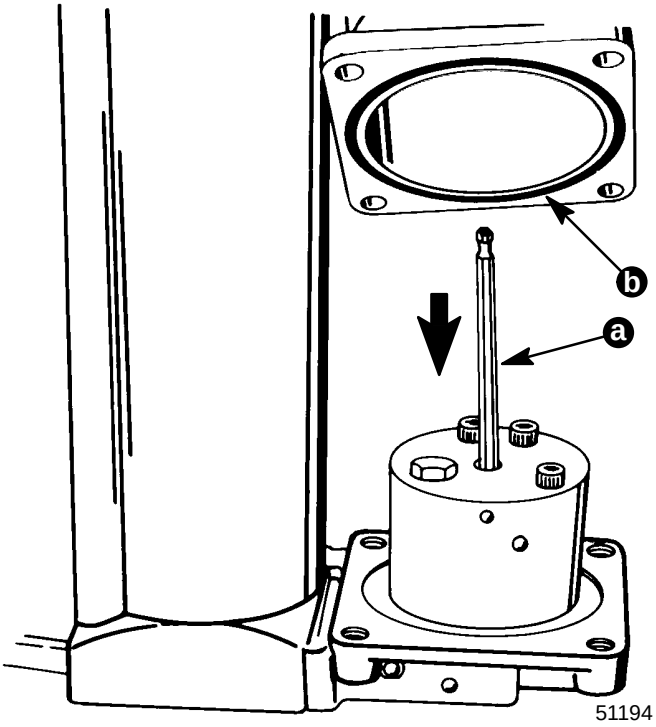
5. Install grommet, washer and screw cap to cylinder end cap. Tighten screw securely.



51195

a - Grommet
b - Washer
c - Screw Cap

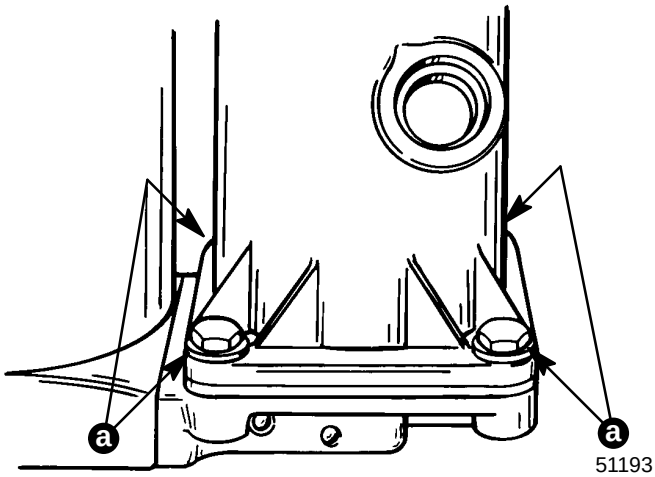
6. Place drive shaft into oil pump.
7. Install lubricated O-ring to base of reservoir.
8. Carefully guide reservoir (with motor) down onto drive shaft.



51194

a - Drive Shaft
b - O-ring

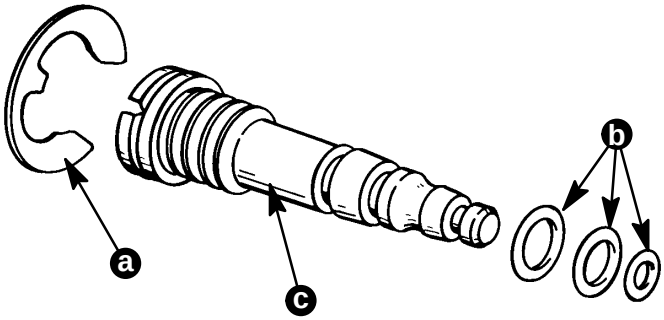
9. Secure reservoir to manifold using four screws. Torque screws to 70 lb. in. (7.9 N·m).



51193

a - Screw

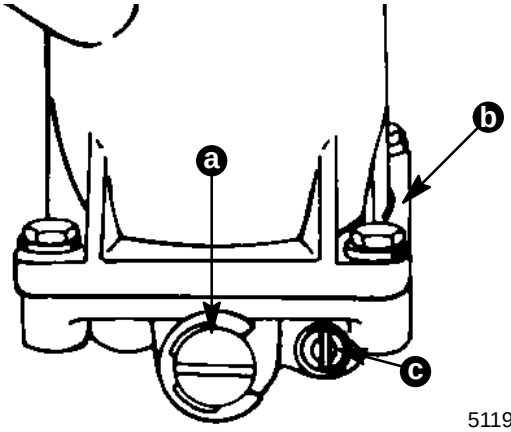
10. Install lubricated O-rings and “E” clip to manual release valve.



51196

a - “E” Clip
b - O-ring
c - Manual Release Valve

11. Insert manual release valve into manifold and tighten snuggly. Back release valve out 3 or 4 turns allowing trim rod installation.

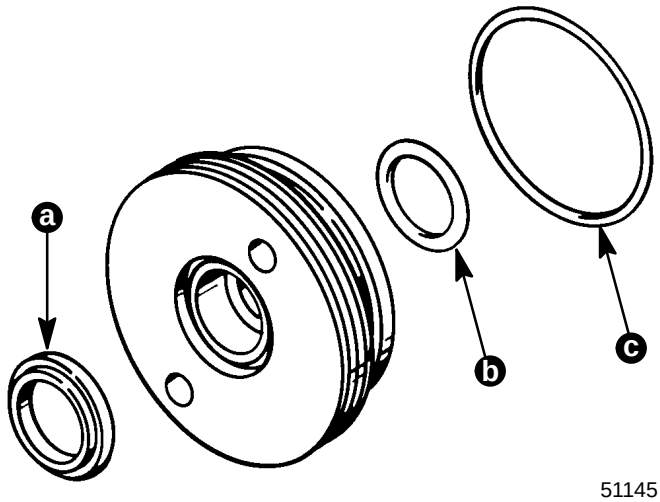


51194

a - Manual Release Valve
b - Manifold
c - Reverse Thrust Valve

Trim Rod Reassembly

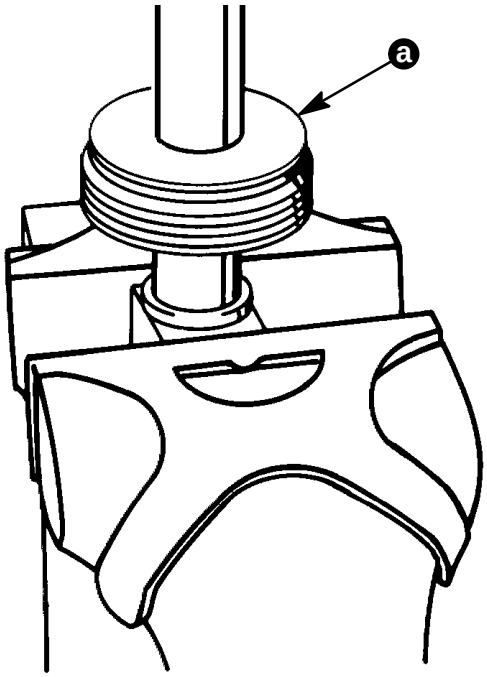
1. Install lubricated O-rings and rod wiper to end cap.



51145

a - Rod Wiper
b - Inner O-ring
c - Outer O-ring

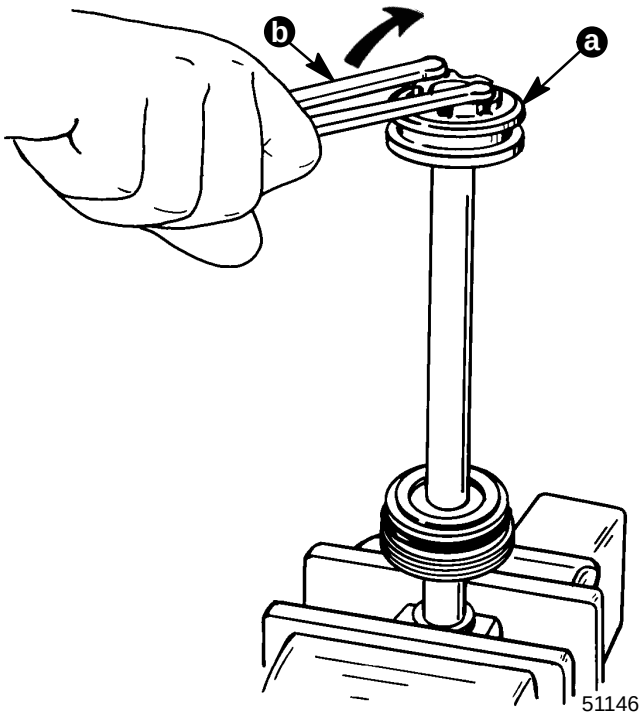
2. Secure trim rod in soft jawed vise as shown.
3. Slide end cap onto trim rod.



51146

a - End Cap

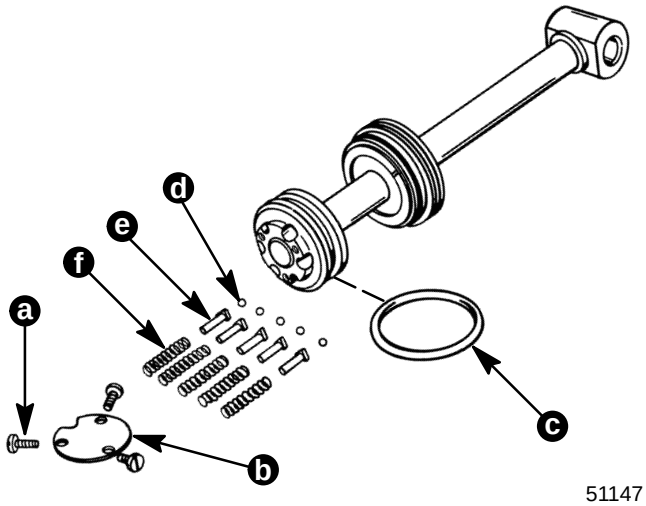
4. Apply Loctite Grade A (271) to threads of trim rod and install trim rod piston. Tighten piston securely using spanner wrench (1/4 in. x 5/16 in. long peg).



51146

a - Trim Rod Piston
b - Spanner Wrench

5. Install lubricated O-ring to trim rod piston.
6. Install check ball components into its respective bore.
7. Secure components in place using plate and screws. Torque screws securely.

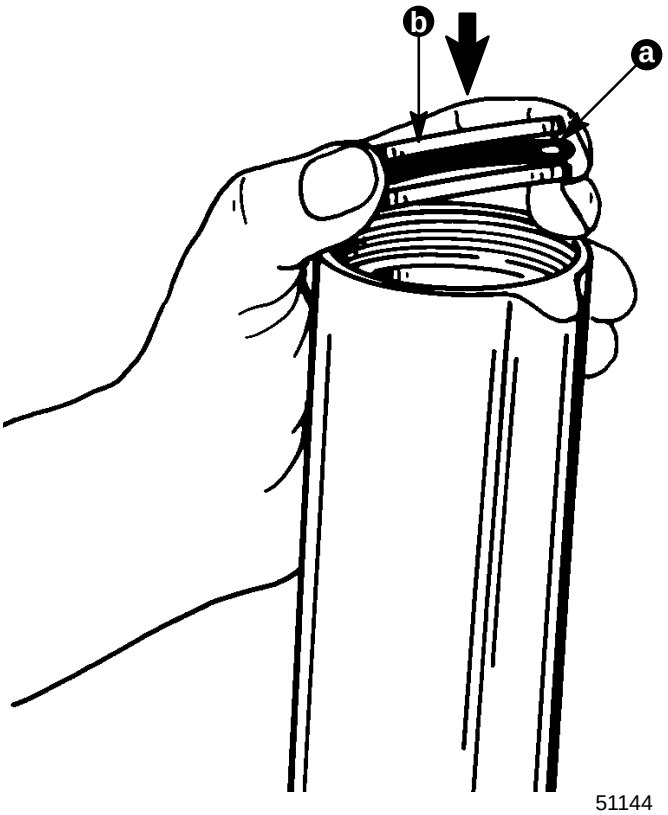


51147

a - Screw
b - Plate
c - O-ring
d - Ball
e - Seat, Spring
f - Spring

Trim Rod Installation

1. Place trim cylinder in soft jawed vise.
2. Fill trim cylinder three inches (76.2mm) from top of cylinder using Quicksilver Power Trim and Steering Fluid or; (ATF) Type F, FA or Dexron II.
3. Install lubricated O-ring to memory piston and place into cylinder. Push piston down to level of oil.

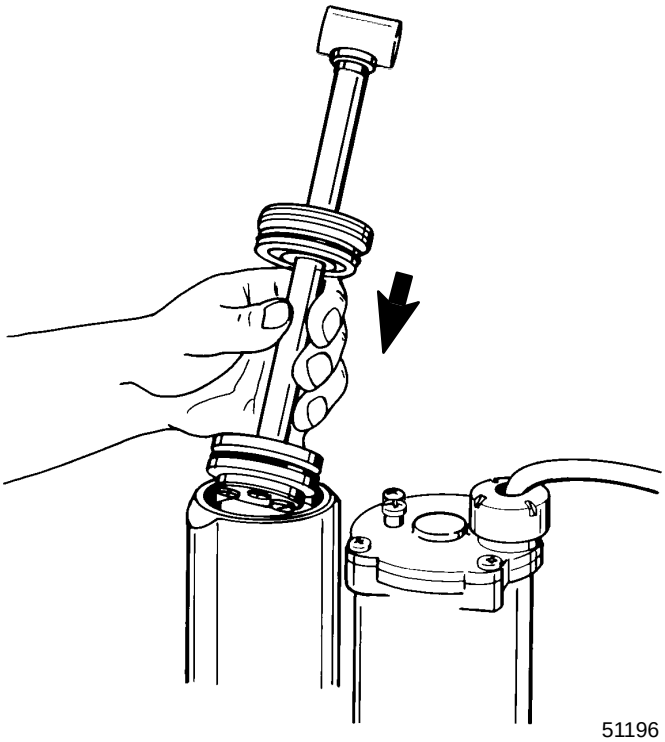


51144

a - O-ring
b - Memory Piston

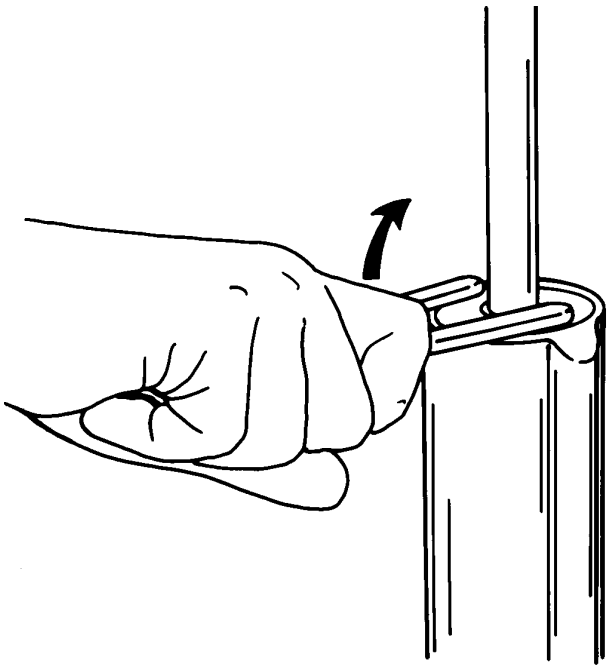
IMPORTANT: Memory piston must not come in contact with trim rod end cap during end cap/trim rod installation.

4. Install trim rod into cylinder.



51196

5. Tighten end cap assembly to cylinder securely using spanner wrench (1/4 in. x 5/16 in. long pegs).



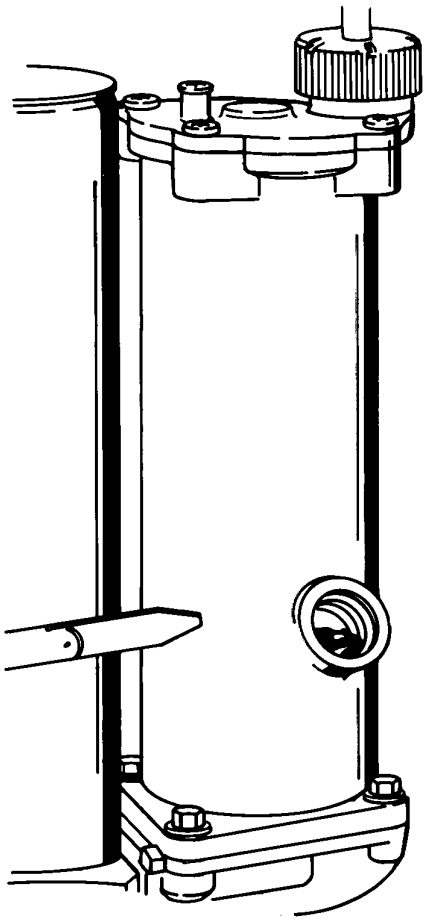
51145

6. Tighten manual release valve snuggly following end cap installation.

Bleeding Power Trim Unit

IMPORTANT: Manual release valve must be in the closed position during power trim bleeding and operation.

1. Secure power trim unit in soft jawed vise.
2. Remove fill screw. Add Quicksilver Power Trim and Steering Fluid (92-90100A12) or Automatic Transmission Fluid (ATF) Type F, FA or Dexron II up to threads of reservoir.

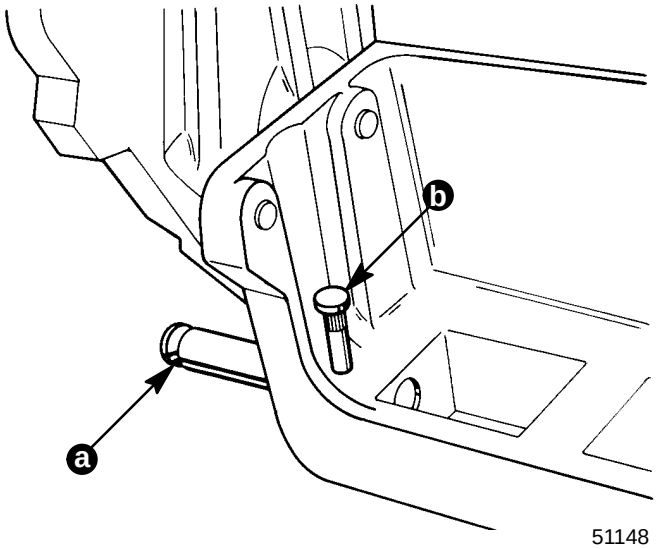


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3. Using a 12 volt power supply connect positive lead to green wire, negative lead to blue wire and drive trim rod to the down position. Connect positive lead to blue wire and negative lead to green wire and drive trim rod to the up position. Recheck fluid level, add fluid if required and repeat cycle until fluid level remains at lower portion of threads.
4. Install fill plug.

Power Trim Unit Installation

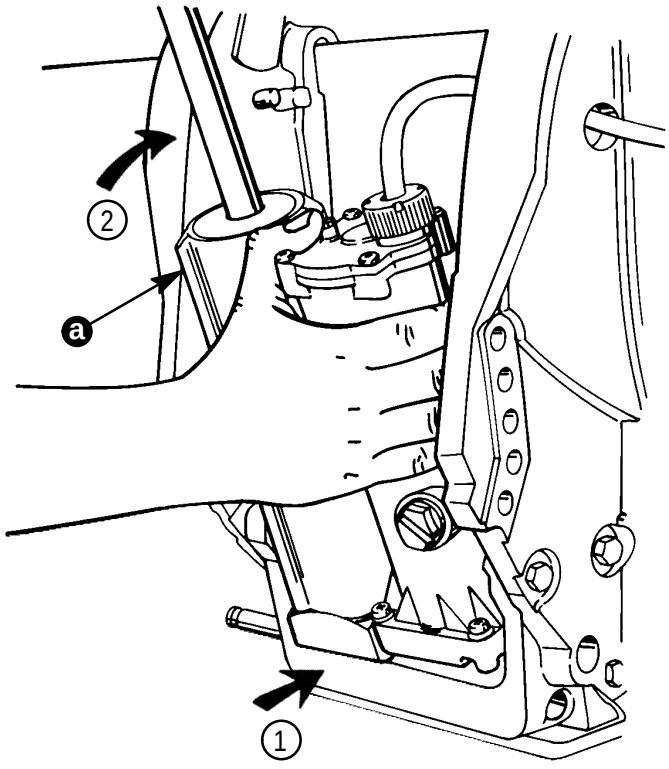
1. Apply Special Lubricant 101 (92-13872A1) to lower pivot pin hole and pivot pin surface.
2. Start lower pivot pin into pivot pin bore and position lower dowel pin (RETAINED) in its respective hole.



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a - Lower Pivot Pin
b - Lower Dowel Pin

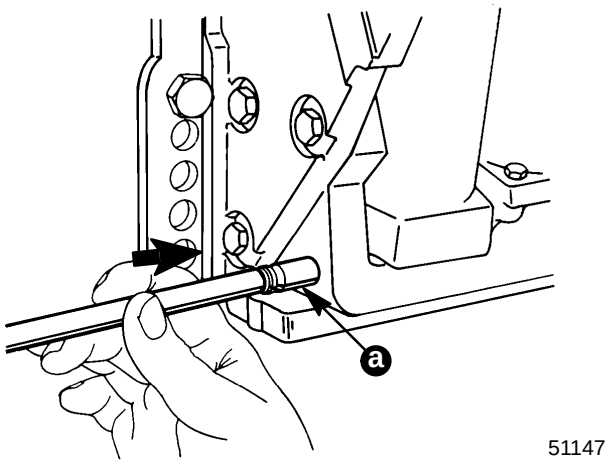
3. Position trim cylinder assembly (BOTTOM FIRST) between clamp brackets and route trim pump electrical harness through access hole in starboard clamp bracket.



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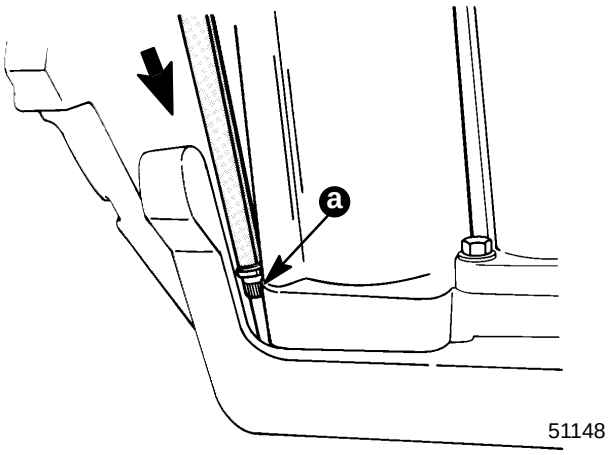
a - Trim Cylinder Assembly

4. Using a suitable punch, drive lower pivot pin into clamp bracket and trim cylinder assembly until pivot pin is flush with outside surface.



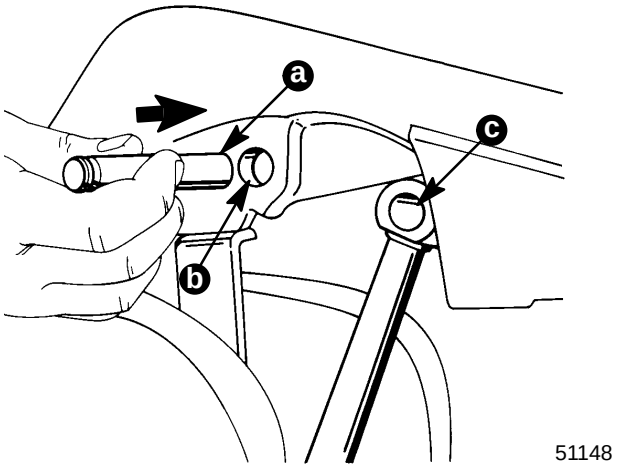
a - Lower Pivot Pin

5. Using a suitable punch, drive lower dowel pin into its respective bore until seated.



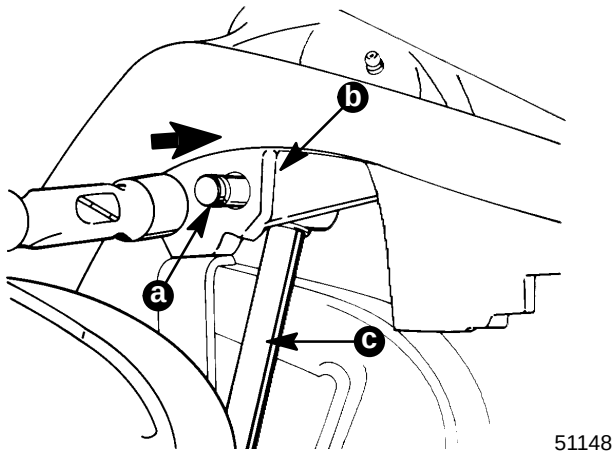
a - Lower Dowel Pin

6. Apply 2-4-C Marine Lubricant (92-90018A12) to surface of upper pivot pin, pivot pin bore and trim ram bore.



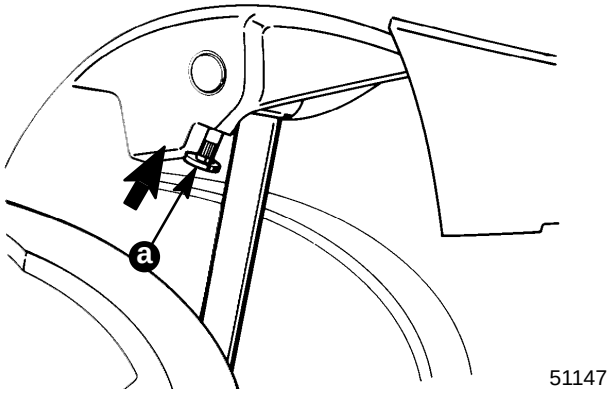
a - Pivot Pin
b - Pivot Pin Bore
c - Trim Ram Bore

7. Using a suitable mallet, drive upper pivot pin into swivel bracket and through trim ram until pivot pin is flushed with swivel bracket.



a - Pivot Pin
b - Swivel Bracket
c - Trim Ram

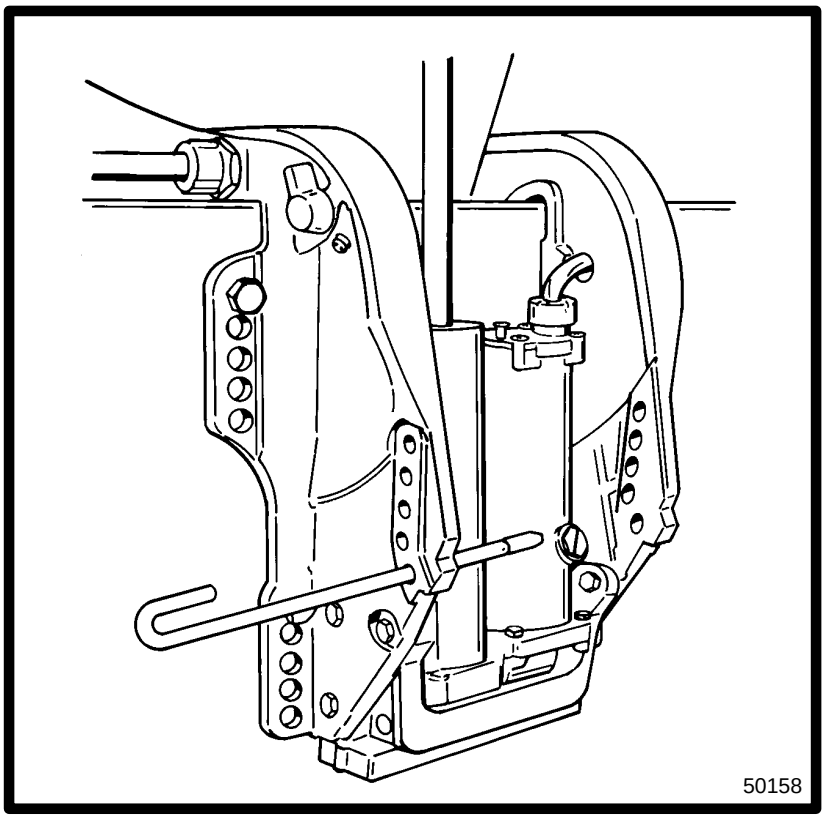
8. Drive upper dowel pin (RETAINED) into its respective hole until seated.



a - Dowel Pin

9. Remove trim fluid fill screw. Fluid level should be to bottom of threads. Add Quicksilver Power Trim and Steering Fluid (92-90100A12) or Automatic Transmission Fluid (ATF) Type F, FA or Dexron II to trim system, if necessary.
10. Reinstall fill screw.
11. Power trim may now be operated to lower outboard to desired position. Trim system is self bleeding.
12. Reconnect spark plug leads to spark plugs.
13. Reinstall top cowl.
14. Connect battery leads to battery terminals.

MID-SECTION



POWER TRIM (DESIGN II)

5

C

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Power Trim General Information

Description

The Power Trim system consists of an electric motor, pressurized fluid reservoir, pump and trim cylinder.

The remote control (or trim panel) is equipped with a switch that is used for trimming the outboard “up” and “down”, and for tilting the outboard for shallow water operation (at slow speed) or for “trailering”. The outboard can be trimmed “up” or “down” while engine is under power or when engine is not running.

Trimming Characteristics

NOTE: *Because varying hull designs react differently in various degrees of rough water, it is recommended to experiment with trim positions to determine whether trimming “up” or “down” will improve the ride in rough water.*

When trimming your outboard from a mid-trim position (trim tab in neutral, straight fore-and-aft, position), you can expect the following results:

TRIMMING OUTBOARD “UP” (“OUT”)

⚠ WARNING

Excessive trim “out” may reduce the stability of some high speed hulls. To correct instability at high speed, reduce the power gradually and trim the motor “In” slightly before resuming high speed operation. (Rapid reduction in power will cause a sudden change of steering torque and may cause additional momentary boat instability.)

Will lift bow of boat, generally increasing top speed.

Transfers steering torque harder to left on installations below 23 in. transom height.

Increases clearance over submerged objects.

In excess, can cause porpoising and/or ventilation.

In excess, can cause insufficient water supply to water pump resulting in serious water pump and/or powerhead overheating damage.

⚠ WARNING

Excessive engine trim angle will result in insufficient water supply to water pump causing water pump and/or powerhead overheating damage. Make sure that water level is above gear housing water intake holes whenever engine is running.

Operating “Up” circuit will actuate the “up” solenoid (located under engine cowl) and close the electric motor circuit. The electric motor will drive the pump, thus forcing automatic transmission fluid thru internal passageways into the “up” side of the trim ram.

The trim cylinder/trim ram will position the engine at the desired trim angle within the 20° maximum trim range. The Power Trim system is designed so the engine cannot be trimmed beyond the 20° maximum trim angle as long as engine RPM is above approximately 2000 RPM.

The engine can be raised beyond the 20° maximum trim angle for shallow water operation, etc., by keeping the engine RPM below 2000 RPM. If engine speed increases above 2000 RPM, the thrust created by the propeller (if deep enough in the water) should cause the trim system to automatically lower the engine back to the 20° maximum trim angle.

TRIMMING OUTBOARD “DOWN” (“IN”)

⚠ WARNING

Excessive speed at minimum trim “In” may cause undesirable and/or unsafe steering conditions. Each boat should be tested for handling characteristics after any adjustment is made to the tilt angle (tilt pin relocation).

Will help planing off, particularly with a heavy load.

Usually improves ride in choppy water.

In excess, can cause boat to veer to the left or right (bow steer).

Transfers steering torque harder to right (or less to the left).

Improves planing speed acceleration (by moving tilt pin one hole closer to transom).

Operating “Down” circuit will actuate the “down” solenoid (located under engine cowl) and close the electric motor circuit (motor will run in opposite direction of the “Up” circuit). The electric motor will drive the pump, thus forcing automatic transmission fluid thru internal passageways into the “down” side of the tilt ram. The tilt ram will move the engine downward to the desired angle.

Trailering Outboard

⚠ WARNING

Excessive engine trim angle will result in insufficient water supply to water pump causing water pump and/or powerhead overheating damage. Make sure that water level is above gear housing water intake holes whenever engine is running.

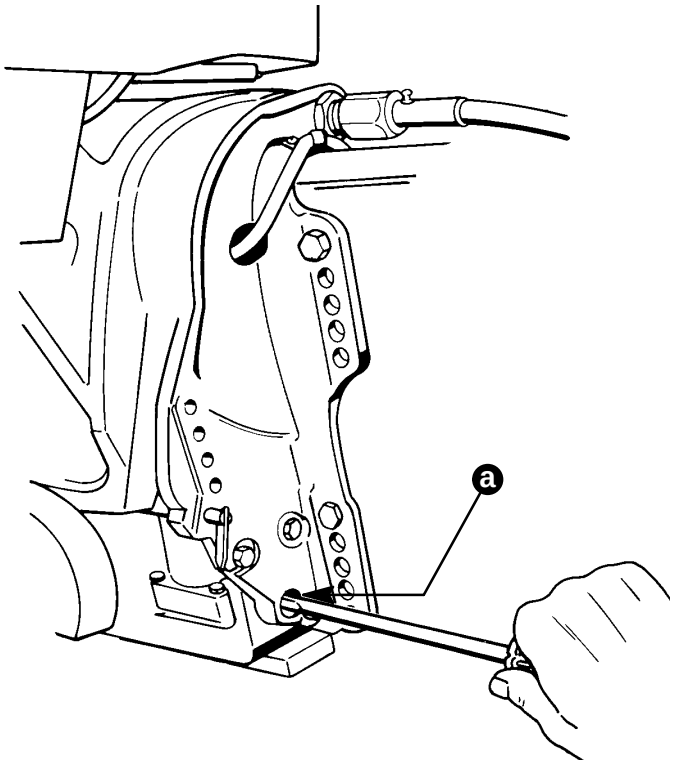
While operating “up” circuit, tilt ram will continue to tilt outboard to full up position for trailering.

Tilting Outboard Up and Down Manually

⚠ WARNING

Before loosening the manual release valve, make sure all persons are clear of engine as engine will drop to full “down” position when valve is loosened.

With power trim installed, the outboard can be raised or lowered manually by opening the manual release valve 3 to 4 turns (counterclockwise).



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a - Manual Release Valve

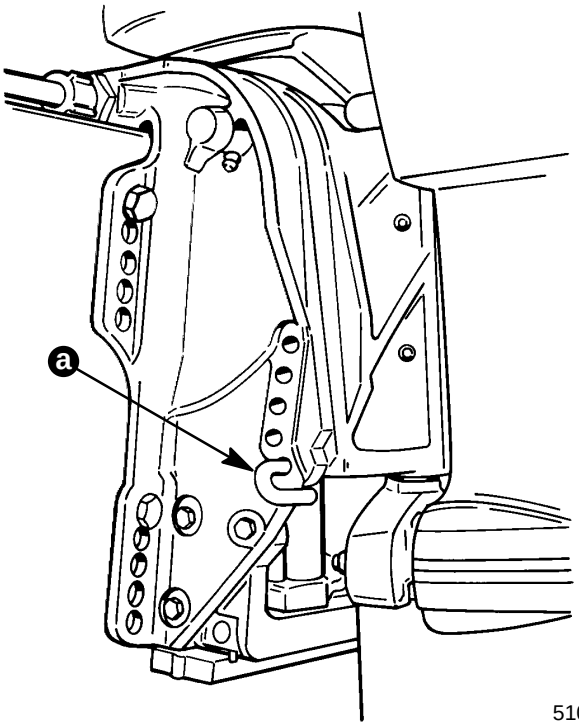
Trim “In” Angle Adjustment

⚠ WARNING

Operating some boats with engine trimmed to the full “in” trim angle [not using trim adjustment pin (a)] at planing speed will cause undesirable and/or unsafe steering conditions. Each boat must be water tested for handling characteristics after engine installation and after any trim adjustments.

IMPORTANT: Some boat/motor combinations, that do not use the trim adjustment pin (a) and are trimmed to the full “in” trim angle, will not experience any undesirable and/or unsafe steering conditions during planing speed. Thus, not using trim adjustment pin may be desired. However, some boats with engine trimmed to the full “in” trim angle at planing speed will cause undesirable and/or unsafe steering conditions. If these steering conditions are experienced, under no circumstances should the engine be operated without the trim adjustment pin and without the pin adjusted in the proper holes to prevent unsafe handling characteristics.

Water test the boat not using the trim adjustment pin. If undesirable and/or unsafe steering conditions are experienced (boat runs with nose down), install trim adjustment pin (a) in proper hole to prevent unsafe handling characteristics.

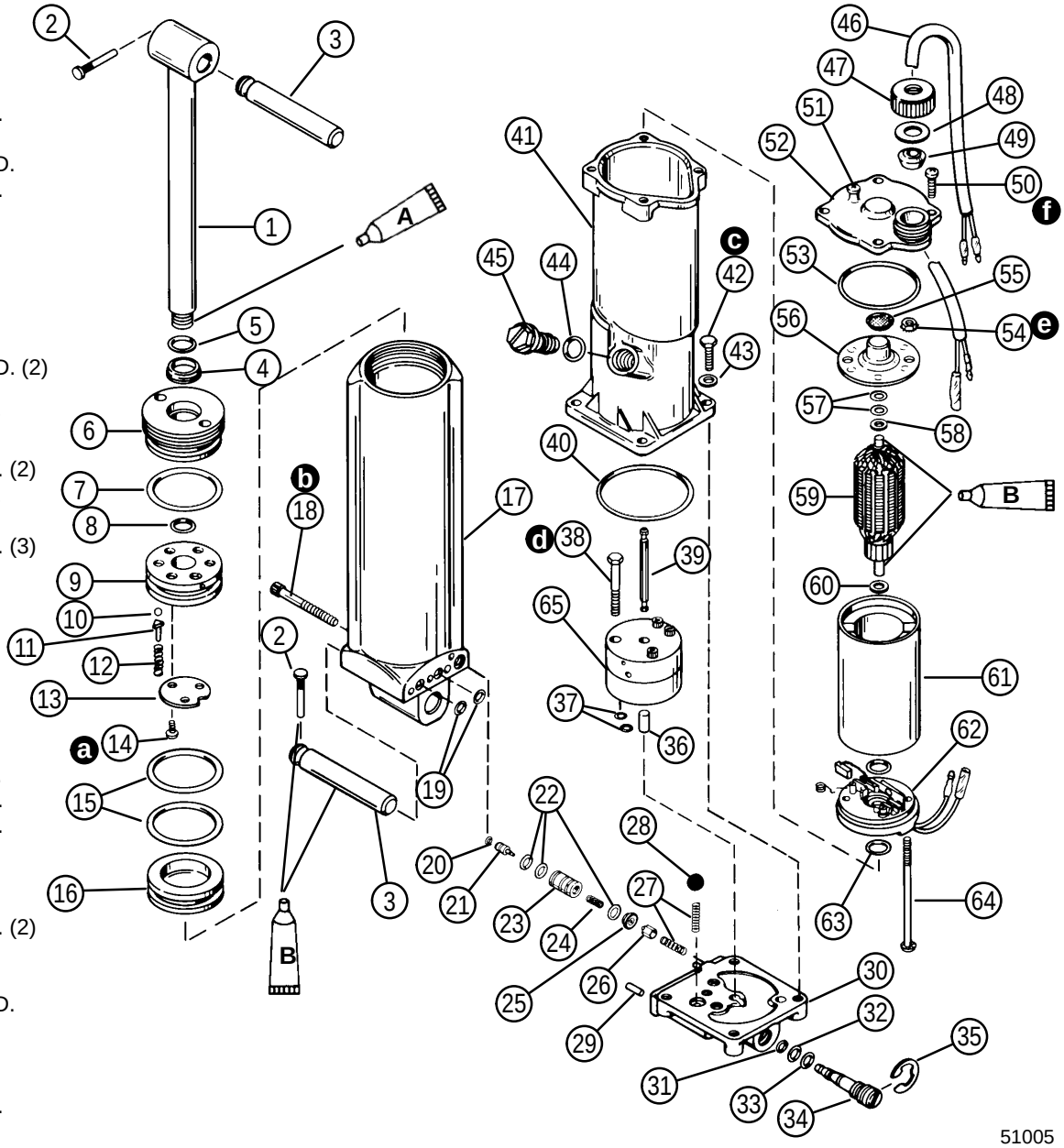


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Power Trim System Components

__NOTE:__ It is recommended that “ALL” O-rings be replaced when servicing tilt system.

1 - Trim Rod
2 - Dowel Pin
3 - Pivot Pin
4 - Rod Wiper
5 - O-ring .671 in. I.D.
6 - Cylinder Cap
7 - O-ring 1.864 in. I.D.
8 - O-ring .614 in. I.D.
9 - Trim Rod Piston
10 - Ball (5)
11 - Seat Spring (5)
12 - Spring (5)
13 - Retainer Plate
14 - Screw (3)
15 - O-ring 1.600 in. I.D. (2)
16 - Memory Piston
17 - Trim Rod Cylinder
18 - Screw (2)
19 - O-ring .208 in. I.D. (2)
20 - O-ring .114 in. I.D.
21 - Spool
22 - O-ring .301 in. I.D. (3)
23 - Sleeve
24 - Spring
25 - Valve Seat
26 - Valve
27 - Spring (2)
28 - Ball
29 - Dowel Pin (2)
30 - Manifold
31 - O-ring .114 in. I.D.
32 - O-ring .208 in. I.D.
33 - O-ring .239 in. I.D.
34 - Relief Valve
35 - “E” Clip
36 - Dowel Pin
37 - O-ring .176 in. I.D. (2)
38 - Bolt
39 - Drive Shaft
40 - O-ring 2.364 in. I.D.
41 - Reservoir
42 - Bolt (4)
43 - Washer (4)
44 - O-ring .538 in. I.D.
45 - Fill Screw
46 - Wire Harness
47 - Cap
48 - Washer
49 - Grommet
50 - Screw (4)
51 - Screw
52 - Reservoir Cap
53 - O-ring 2.634 in. I.D.
54 - Nut (2)
55 - Disk Foam Pad
56 - End Cap
57 - Washer (2; .030 in. Thick)
58 - Thrust Washer
59 - Armature
60 - Washer (.010 in. Thick)
61 - Housing
62 - End Frame
63 - O-ring .489 in. I.D.
64 - Bolt (2)
65 - Trim Pump



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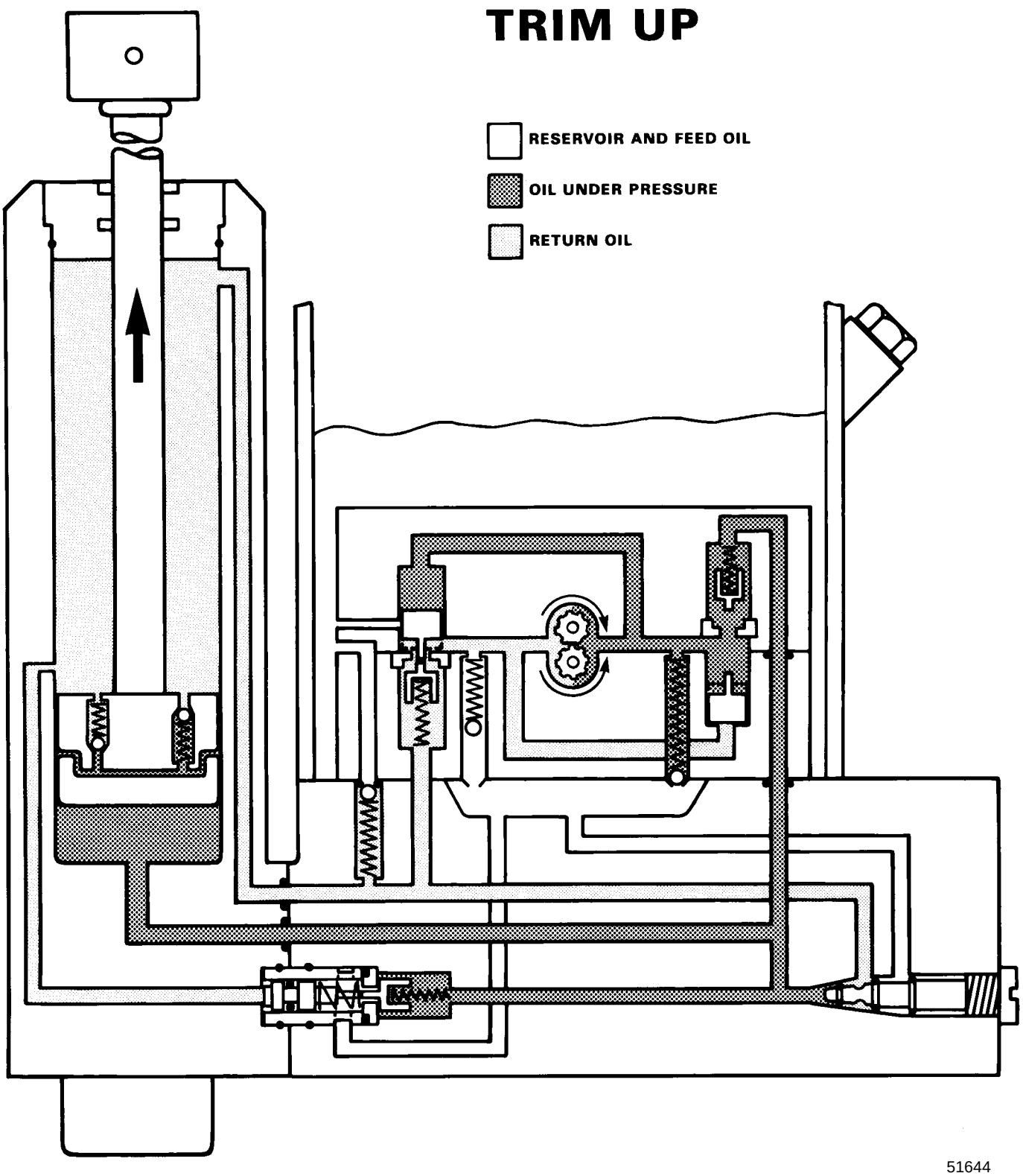
Torque Specifications

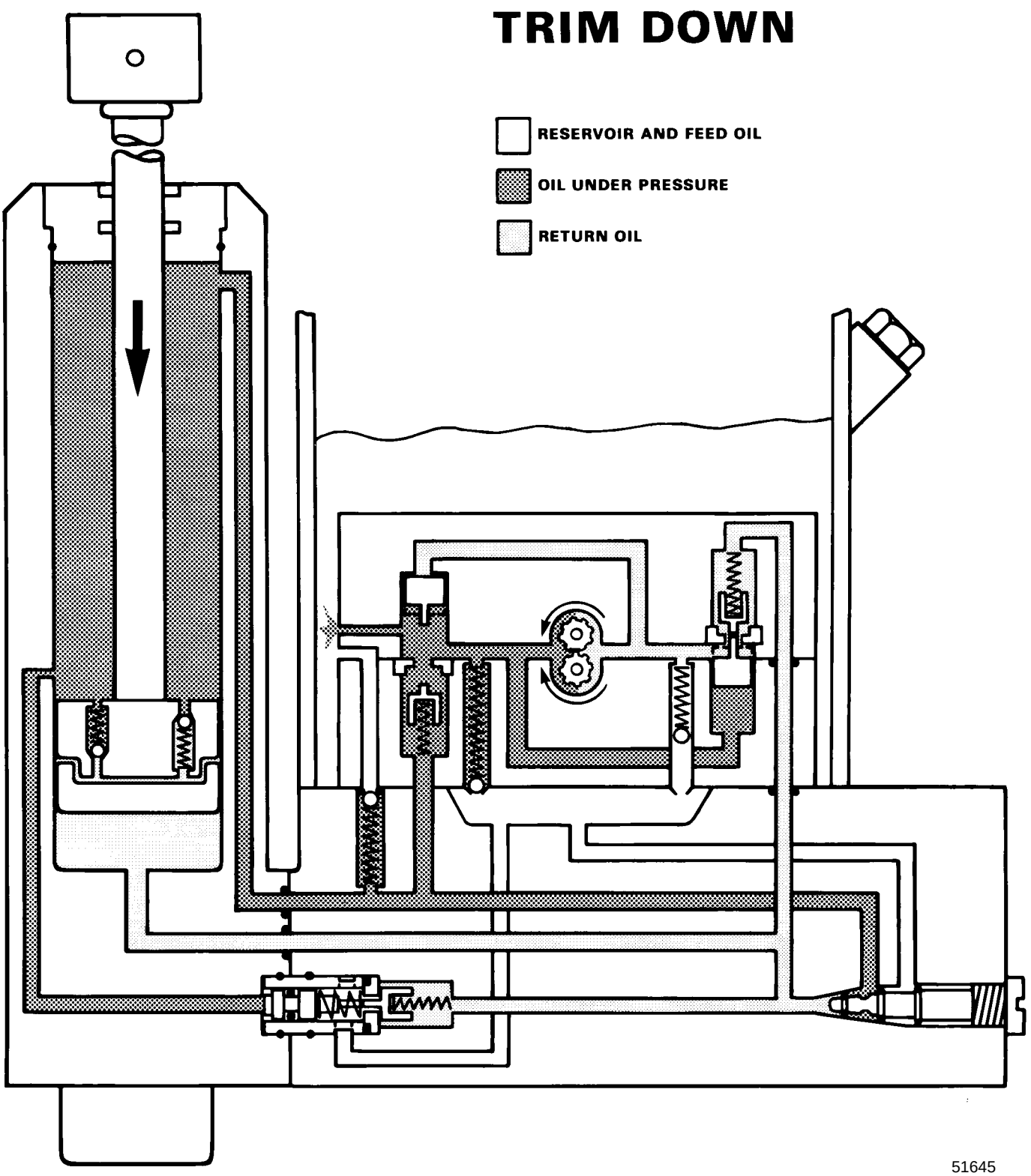
- (a) 35 lb. in. (4.0 N·m)
- (b) 100 lb. in. (11.3 N·m)
- (c) 70 lb. in. (7.9 N·m)
- (d) 90 lb. in. (10.2 N·m)
- (e) 25 lb. in. (2.8 N·m)
- (f) 13 lb. in. (1.5 N·m)

Quicksilver Lubricant/Sealant Application Points

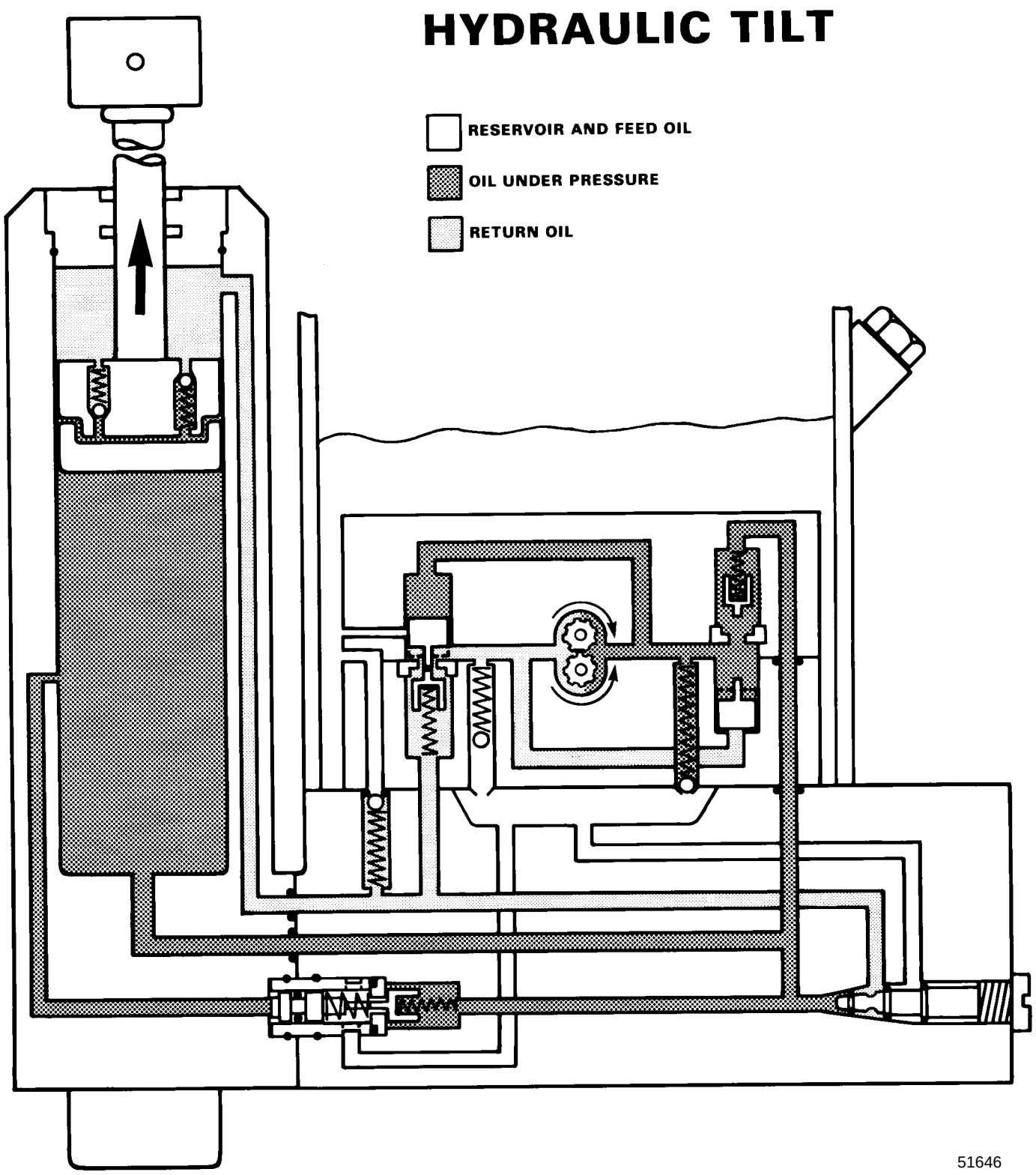
- A — Loctite Grade “A” (271)
- B — Special Lubricant 101

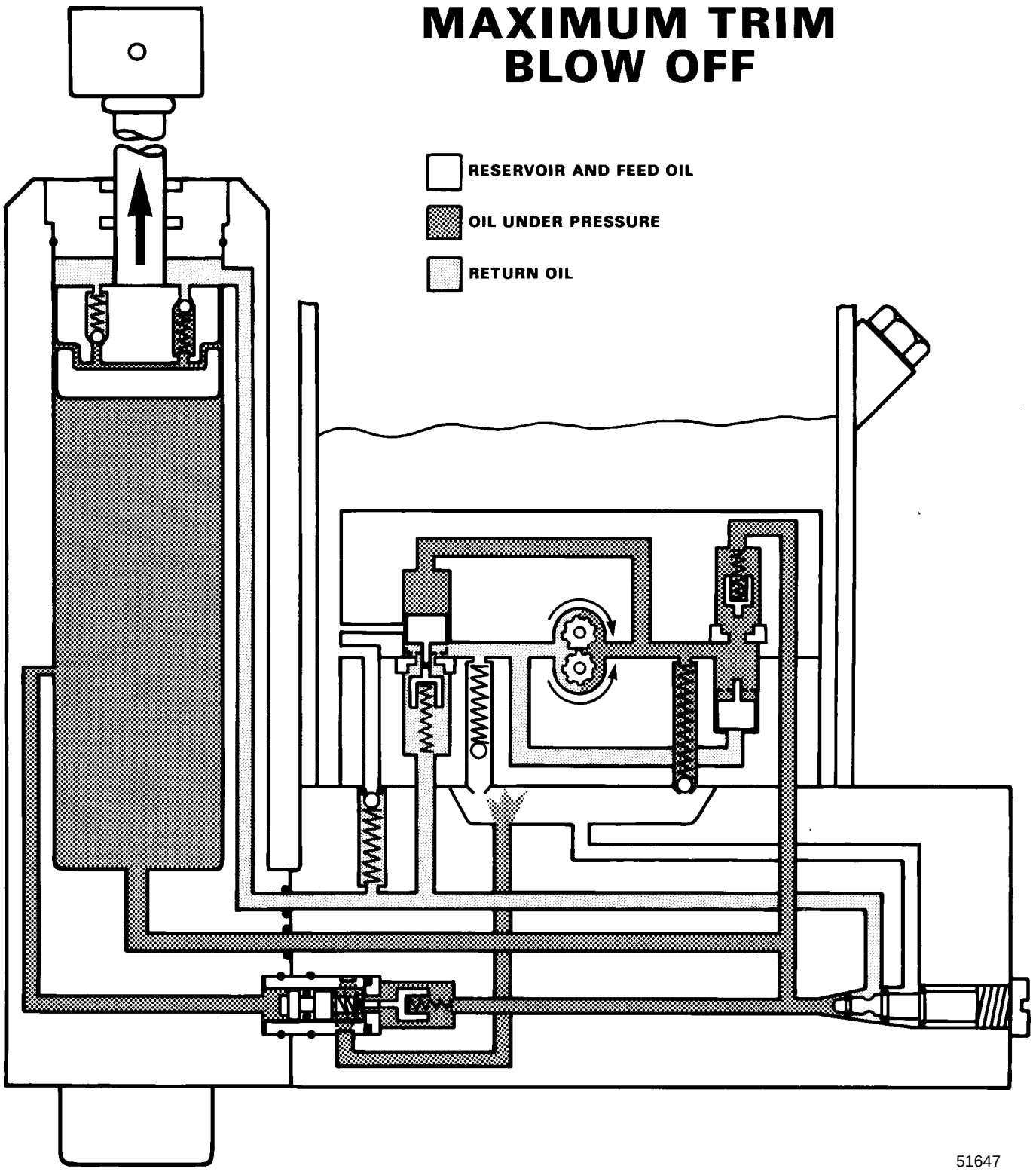
Power Trim Flow Diagrams
Design II



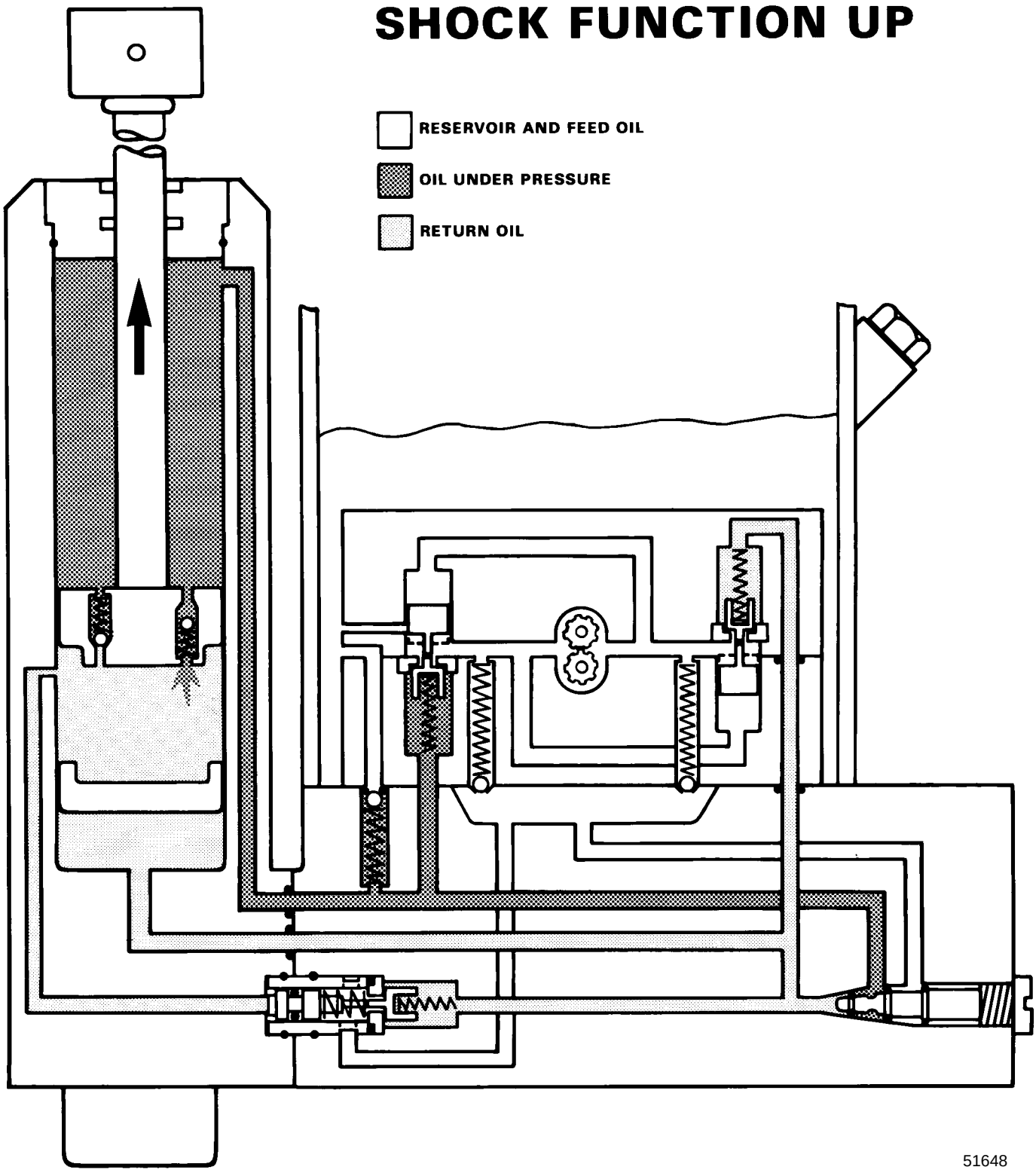

TRIM DOWN
RESERVOIR AND FEED OIL
OIL UNDER PRESSURE
RETURN OIL
51645

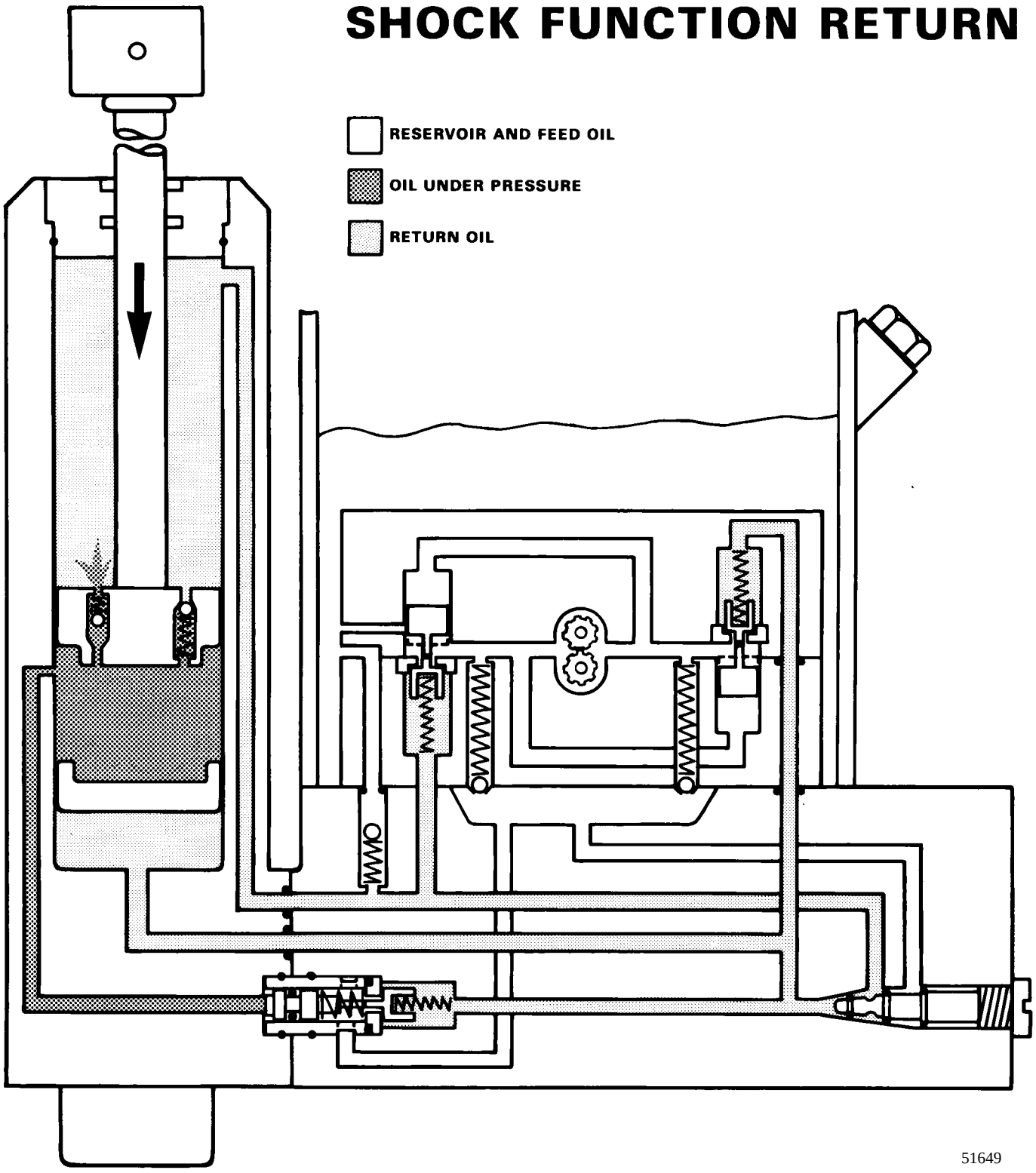
Design II


HYDRAULIC TILT
RESERVOIR AND FEED OIL
OIL UNDER PRESSURE
RETURN OIL
51646

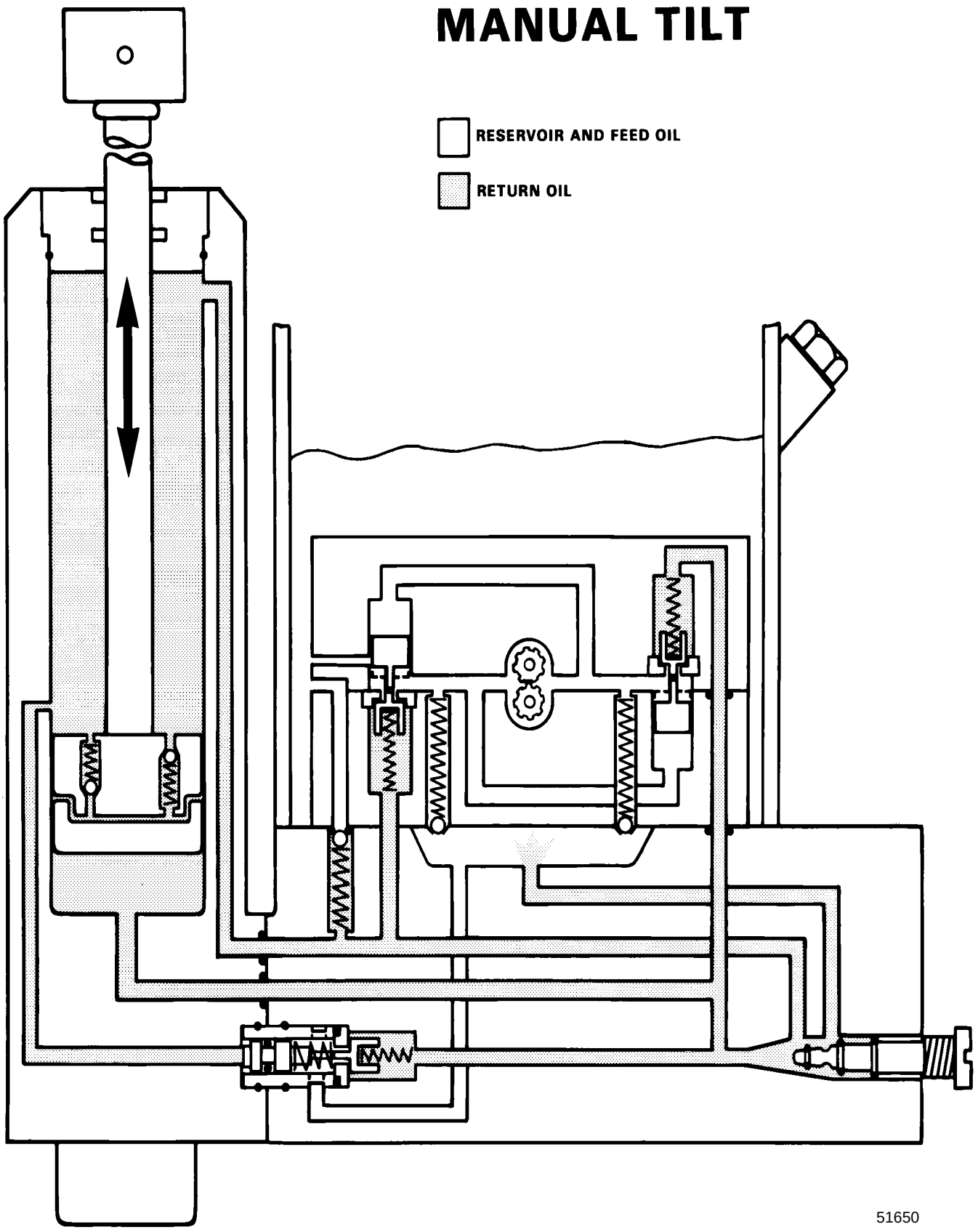

MAXIMUM TRIM
BLOW OFF
RESERVOIR AND FEED OIL
OIL UNDER PRESSURE
RETURN OIL
51647

Design II


SHOCK FUNCTION UP
RESERVOIR AND FEED OIL
OIL UNDER PRESSURE
RETURN OIL
51648


SHOCK FUNCTION RETURN
RESERVOIR AND FEED OIL
OIL UNDER PRESSURE
RETURN OIL
51649

Design II

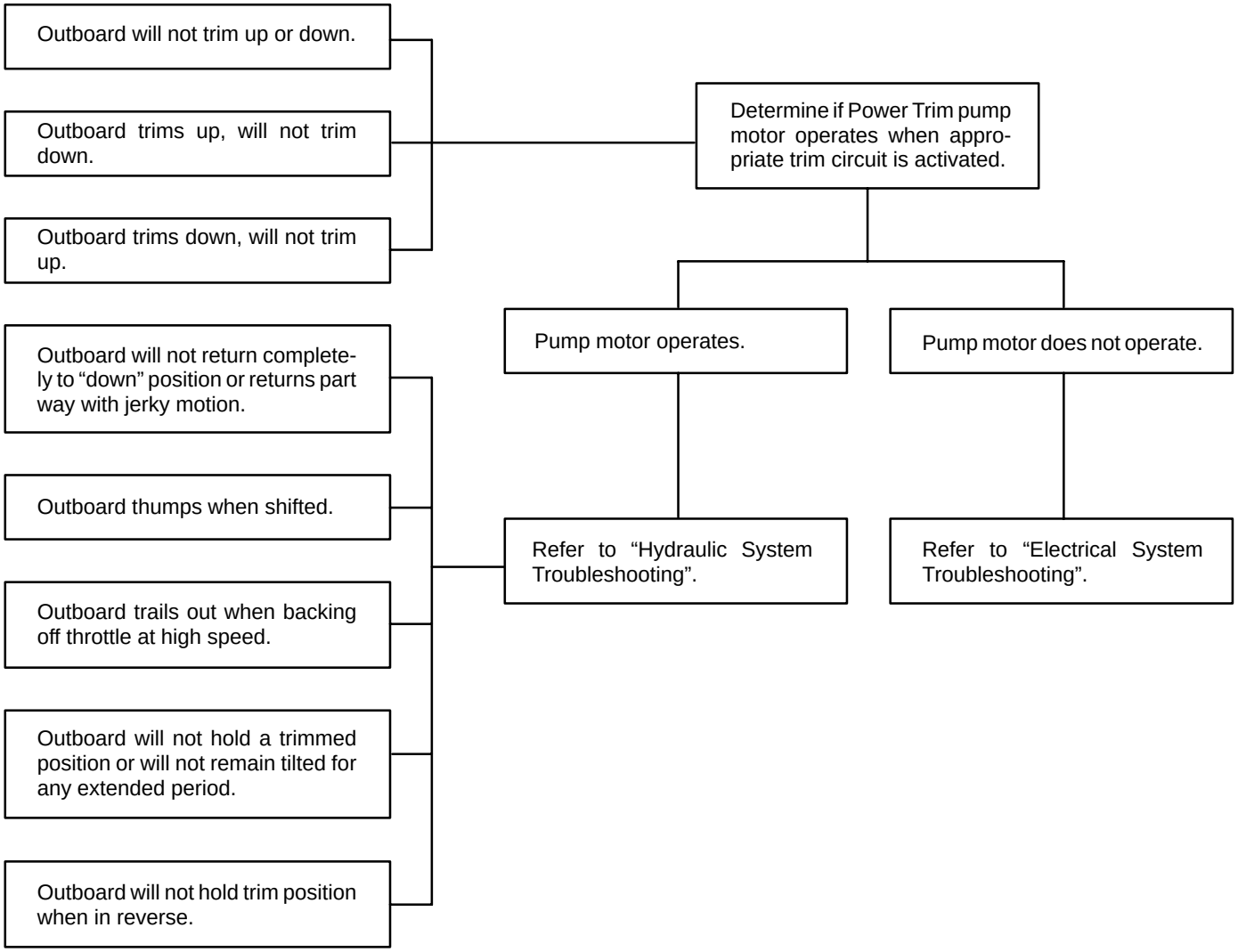


Troubleshooting

Determining if Problem is Electrical or Hydraulic

Refer to the following chart to determine which system is at fault.

Trouble Chart


Outboard will not trim up or down.
Outboard trims up, will not trim down.
Outboard trims down, will not trim up.
Outboard will not return completely to “down” position or returns part way with jerky motion.
Outboard thumps when shifted.
Outboard trails out when backing off throttle at high speed.
Outboard will not hold a trimmed position or will not remain tilted for any extended period.
Outboard will not hold trim position when in reverse.
Determine if Power Trim pump motor operates when appropriate trim circuit is activated.
Pump motor operates.
Pump motor does not operate.
Refer to “Hydraulic System Troubleshooting”.
Refer to “Electrical System Troubleshooting”.

Hydraulic System Troubleshooting

Support outboard with tilt lock lever when servicing power trim system.

IMPORTANT: After debris or failed components have been found (during troubleshooting procedure) it is recommended that unit be disassembled completely and ALL O-rings be replaced. Check ball valve components and castings must be cleaned using engine cleaner and compressed air or replaced prior to reassembly.

IMPORTANT: Power trim system is pressurized. Outboard must be in the full "UP" position (trim rod fully extended) prior to fill/drain plug, or manual release valve removal.

Refer to instructions following if disassembly is required when servicing.

Follow preliminary checks before proceeding to troubleshooting flow diagrams (following).

Preliminary Checks

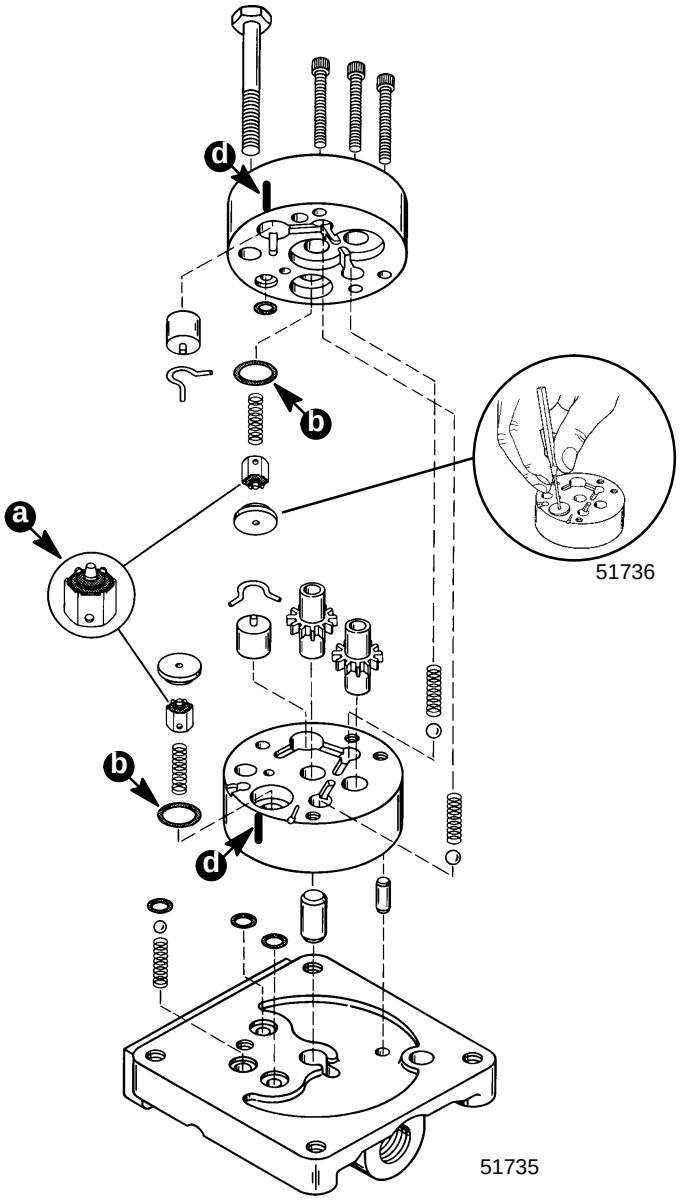
IMPORTANT: Operate Power Trim system after each check to see if problem has been corrected. If problem has not been corrected proceed to next check.

1. Check that manual release valve is tightened to full right (clockwise) position.
2. Check trim pump fluid level with outboard in full "UP" position and fill if necessary. Refer to "Bleeding Power Trim Unit".
3. Check for external leaks in Power Trim system. Replace defective part(s) if leak is found.
4. Outboard not holding tilted position (falls down to trim position) indicates debris or defective components in trim valve assembly. Clean or replace components as required.
5. Check manual release valve for broken stem and one O-ring remaining in the release valve passage. (Separate the manifold assembly from the cylinder to dislodge broken stem.) Install new release valve and test system.
6. Check for nicked, deteriorated or misplaced O-rings throughout trim system.

Leak Down Check – Pump and Manifold Assembly

***NOTE:** Scribe (d) pump housing halves before disassembly. Check pump for problems as follows:*

1. Debris or chips between valve and seat (a). Usually imbedded in rubber valve seat.
2. Nicked or deteriorated O-ring (b).
3. Nicked, deteriorated or misplaced O-ring between manifold and trim cylinder. Refer to **"Manifold Removal"** for O-ring location.

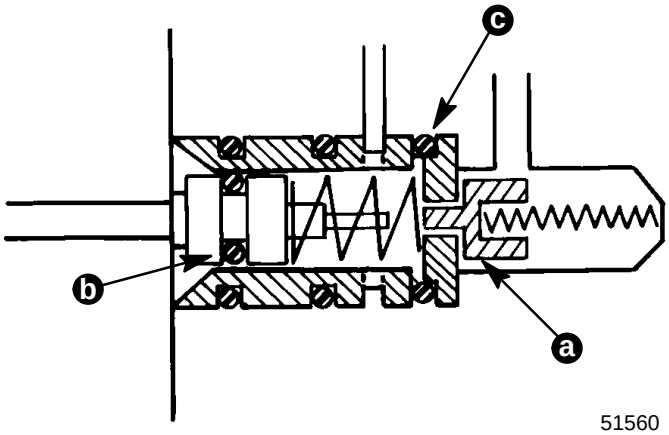


4. After reassembly, insert drive shaft and check pump rotation resistance to turning – housing halves can shift/turn during reassembly. Align scribe marks (d) carefully.

Leak Down Check – Pilot Valve Assembly

1. Debris or chips between valve and seat (a), usually imbedded in rubber valve seat.
2. Pilot valve installed from non-chamfered end of spool results in nicked or damaged O-ring (b).
3. Nicked or deteriorated O-ring (c).

A leak path is created between the UP side of the cylinder and the reservoir. The trim system will leak DOWN until the trim port in cylinder is covered.

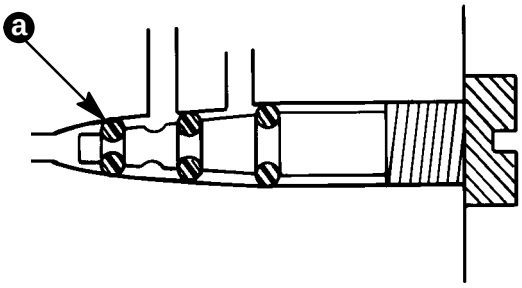


51560

a - Valve and Seat
b - Pilot Valve O-ring
c - O-ring

Leak Down Check – Manual Release Valve

1. Debris or chips under O-ring (a).
2. Flash from valve molding causing O-ring (a) to not seal.
3. Nicked O-ring (a).



51560

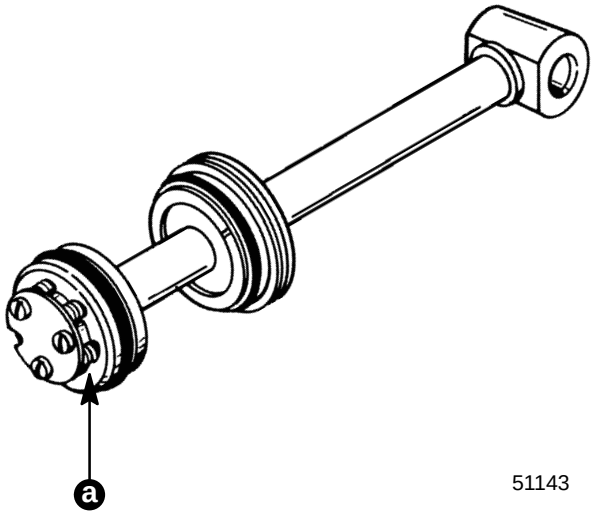
a - O-ring

Leakage Past Ball and Seat – Piston Assembly

Unit will trim to full or near full DOWN position and then will begin to trim UP while trim switch is held in “DOWN” mode.

If trim switch is released, outboard can be pushed (by hand) DOWN to the point where trim UP started.

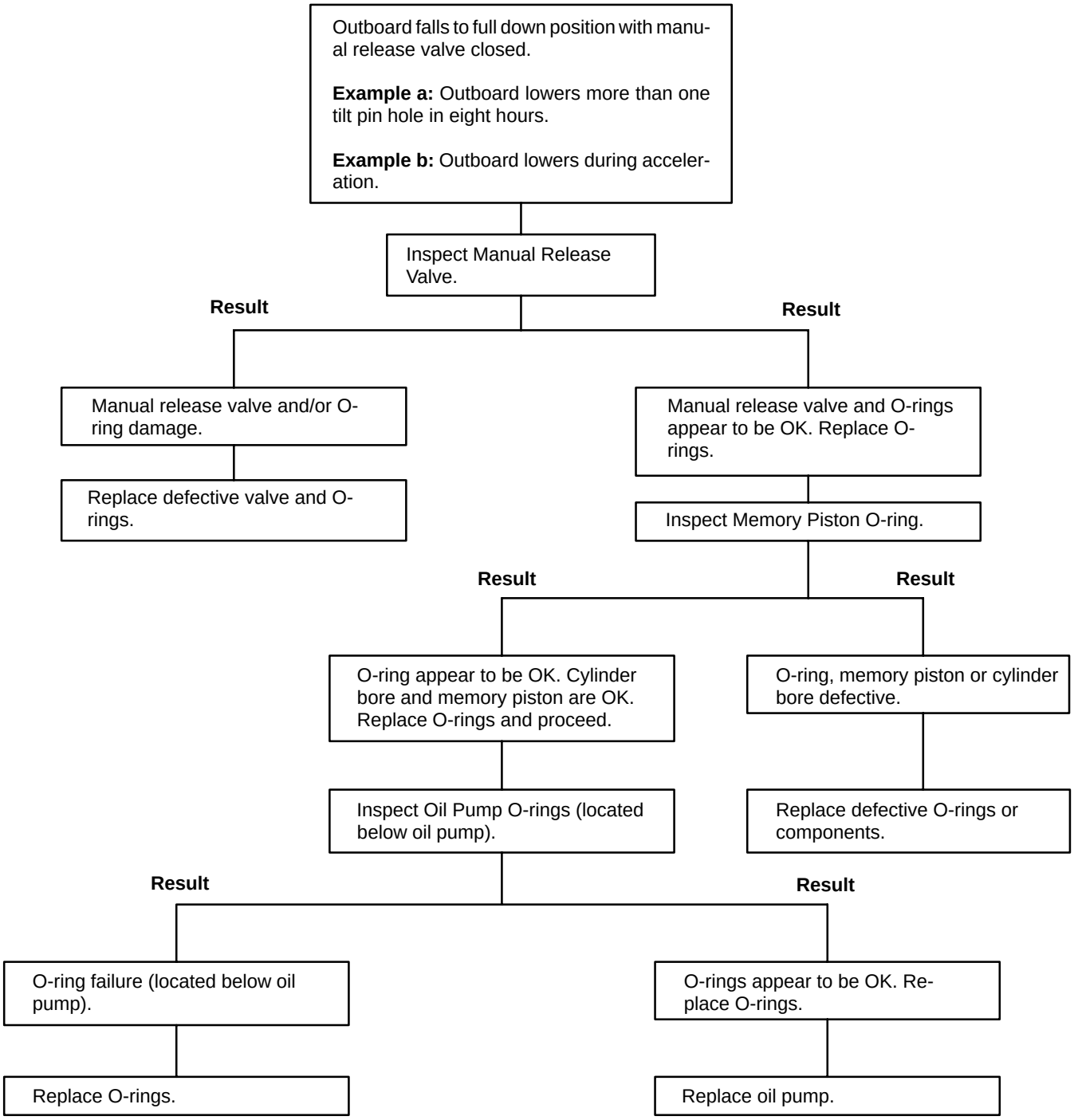
1. Inspect balls and seats in piston assembly for debris or damage. Repair or replace balls/seats.



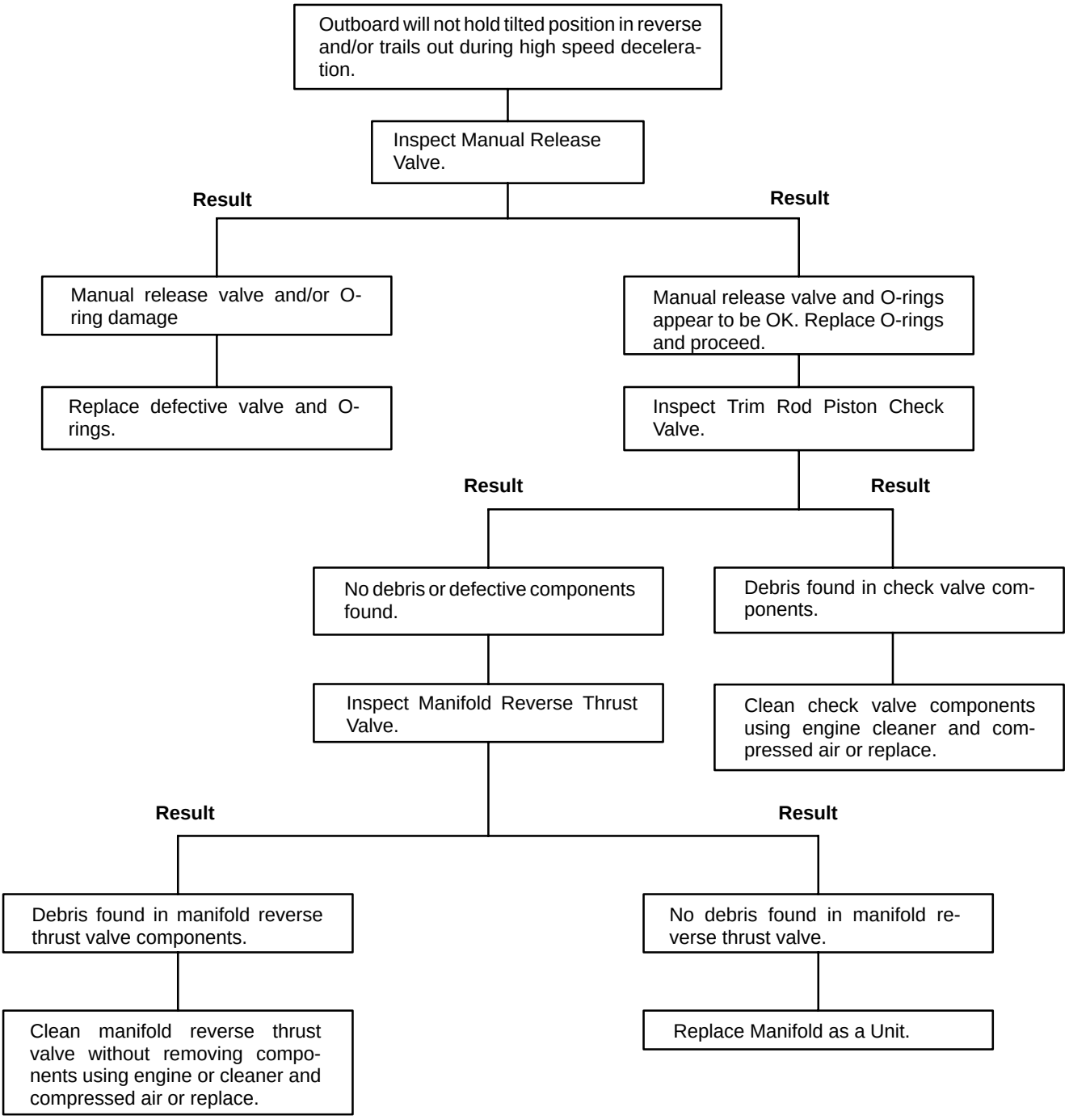
51143

a - Ball and Seat. Check for Debris or Damage

Troubleshooting Flow Diagram

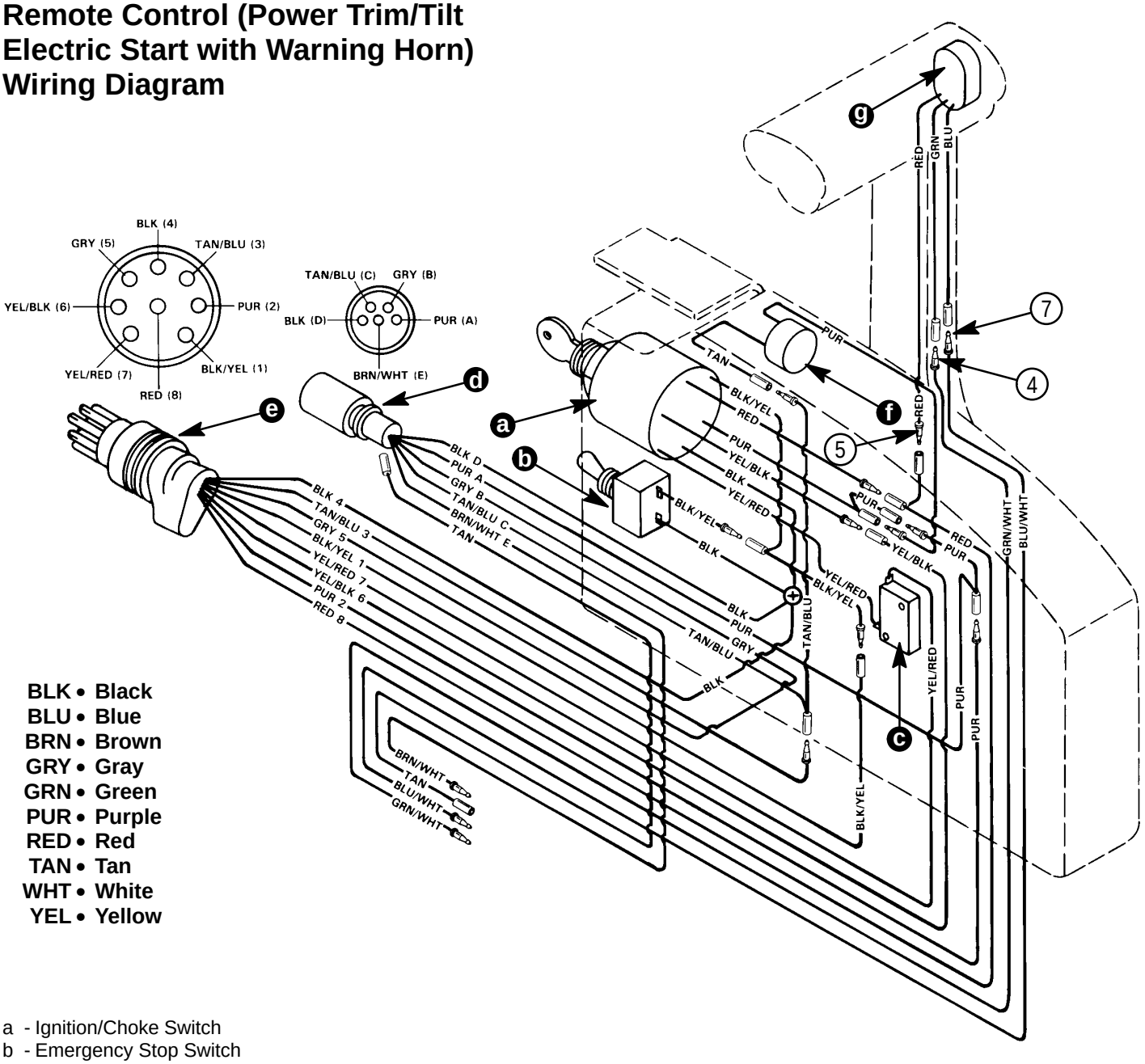

Outboard falls to full down position with manual release valve closed.
Example a: Outboard lowers more than one tilt pin hole in eight hours.
Example b: Outboard lowers during acceleration.
Inspect Manual Release Valve.
Result
Result
Manual release valve and/or O-ring damage.
Replace defective valve and O-rings.
Manual release valve and O-rings appear to be OK. Replace O-rings.
Inspect Memory Piston O-ring.
Result
Result
O-ring appear to be OK. Cylinder bore and memory piston are OK. Replace O-rings and proceed.
Inspect Oil Pump O-rings (located below oil pump).
O-ring, memory piston or cylinder bore defective.
Replace defective O-rings or components.
Result
Result
O-ring failure (located below oil pump).
Replace O-rings.
O-rings appear to be OK. Replace O-rings.
Replace oil pump.

Troubleshooting Flow Diagram


Outboard will not hold tilted position in reverse and/or trails out during high speed deceleration.
Inspect Manual Release Valve.
Result
Result
Manual release valve and/or O-ring damage
Manual release valve and O-rings appear to be OK. Replace O-rings and proceed.
Replace defective valve and O-rings.
Inspect Trim Rod Piston Check Valve.
Result
Result
No debris or defective components found.
Debris found in check valve components.
Inspect Manifold Reverse Thrust Valve.
Clean check valve components using engine cleaner and compressed air or replace.
Result
Result
Debris found in manifold reverse thrust valve components.
No debris found in manifold reverse thrust valve.
Clean manifold reverse thrust valve without removing components using engine or cleaner and compressed air or replace.
Replace Manifold as a Unit.

Electrical System Troubleshooting

COMMANDER 2000 Side Mount Remote Control (Power Trim/Tilt Electric Start with Warning Horn) Wiring Diagram



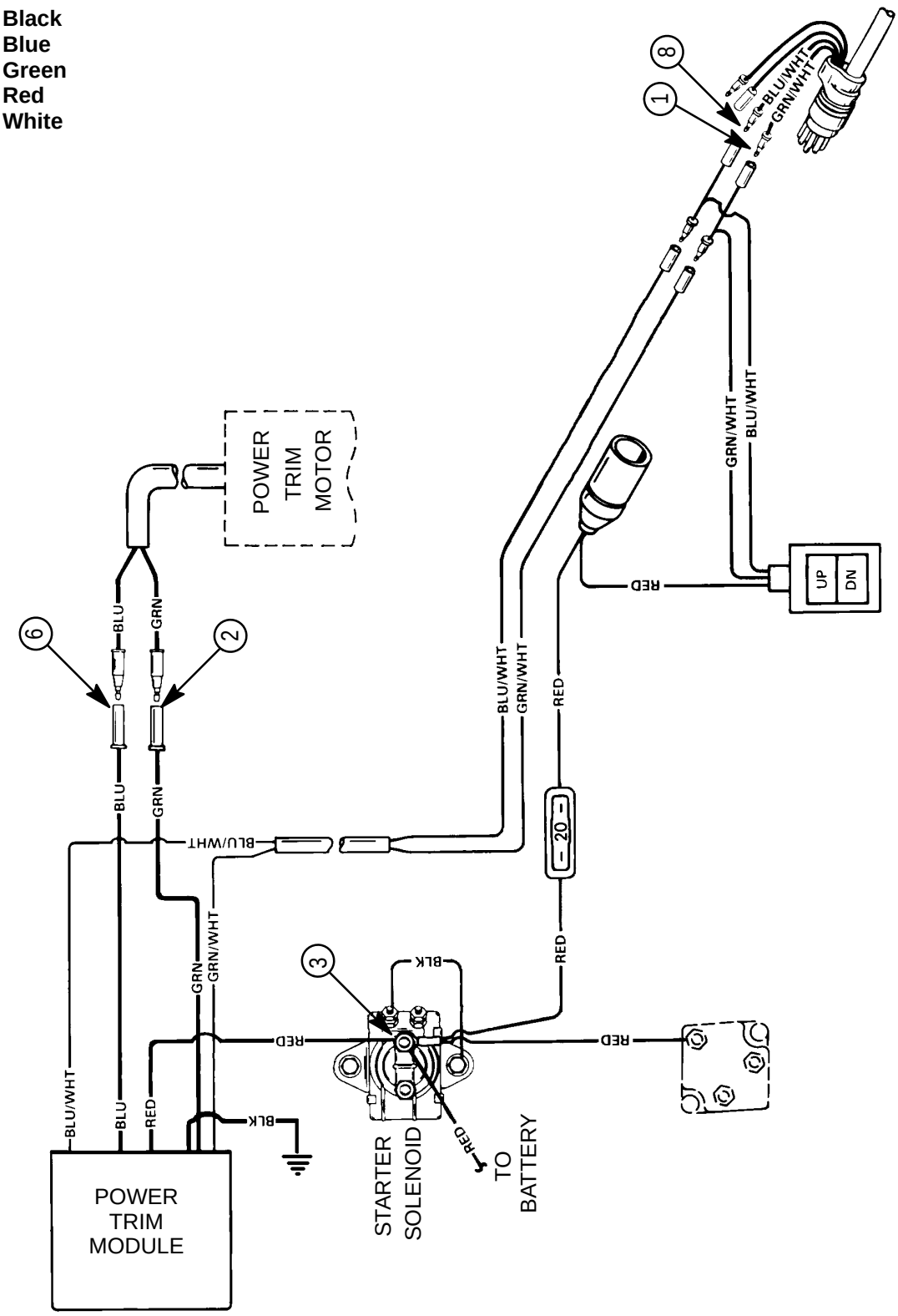
BLK • Black
BLU • Blue
BRN • Brown
GRY • Gray
GRN • Green
PUR • Purple
RED • Red
TAN • Tan
WHT • White
YEL • Yellow

a - Ignition/Choke Switch
b - Emergency Stop Switch
c - Neutral Start Switch
d - Tachometer/Accessories Harness Connector
e - Wiring Harness Connector
f - Warning Horn
g - Trim/Tilt Switch

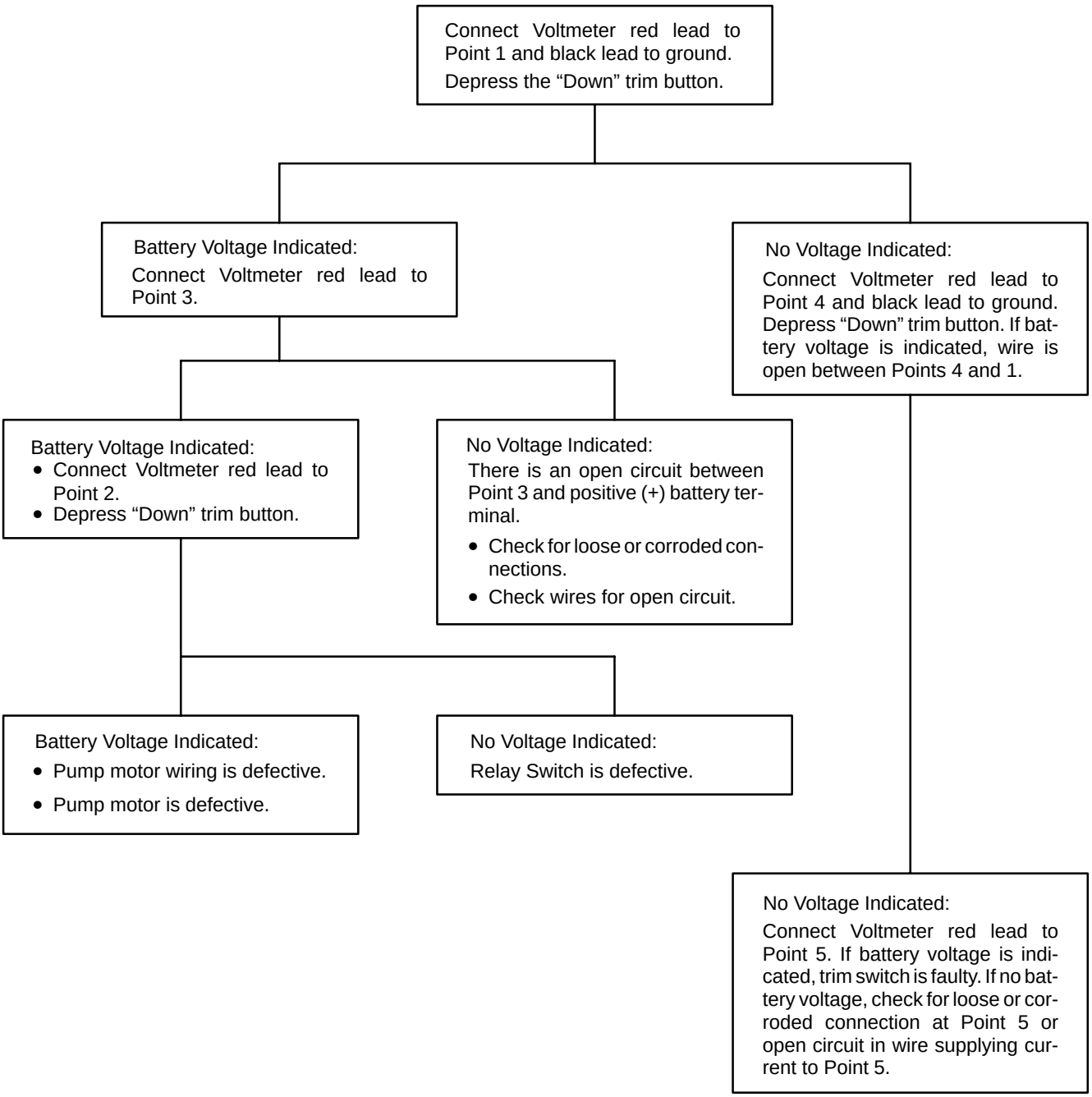
23891

Power Trim System Wiring Diagram

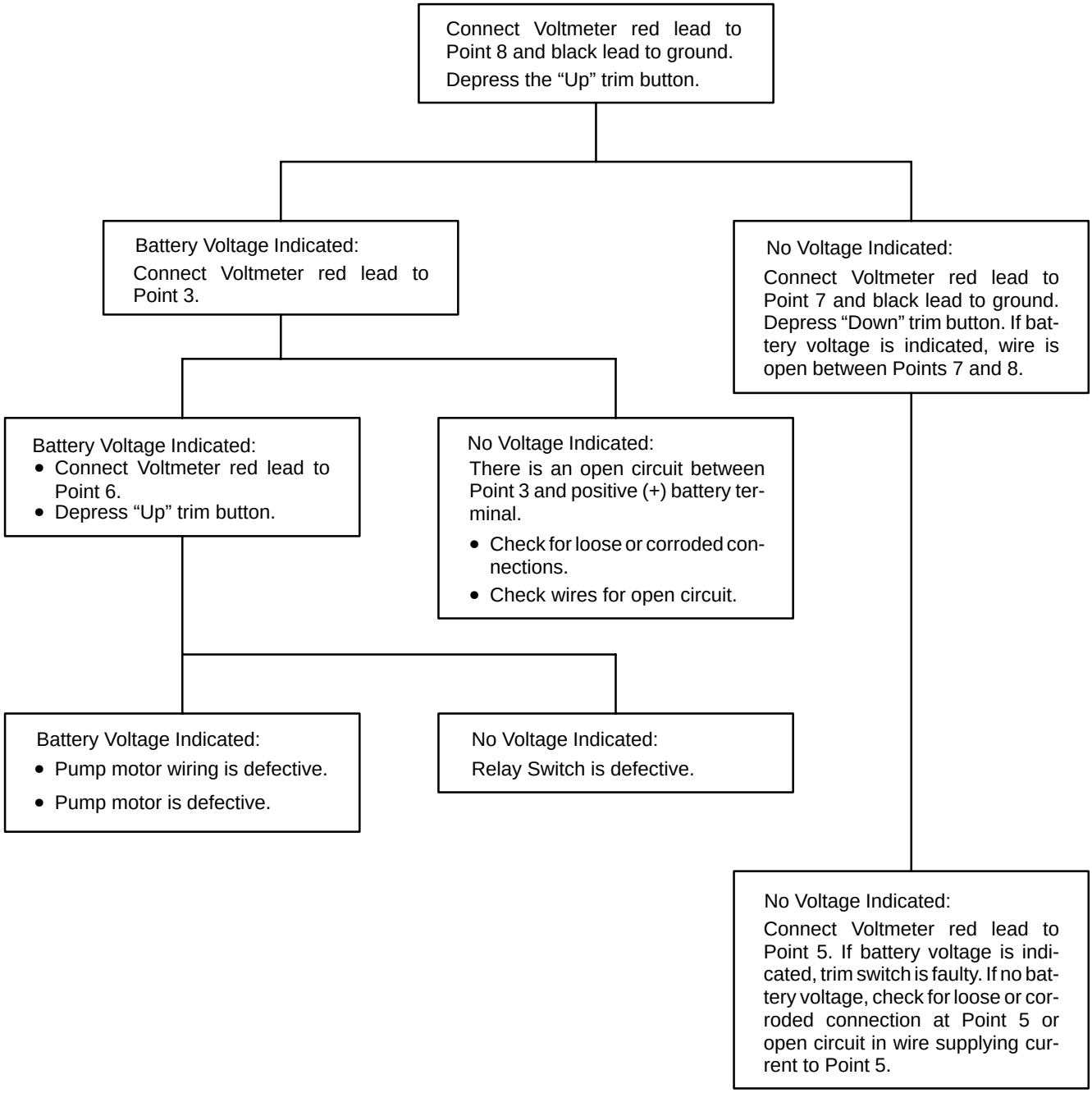
BLK • Black
BLU • Blue
GRN • Green
RED • Red
WHT • White



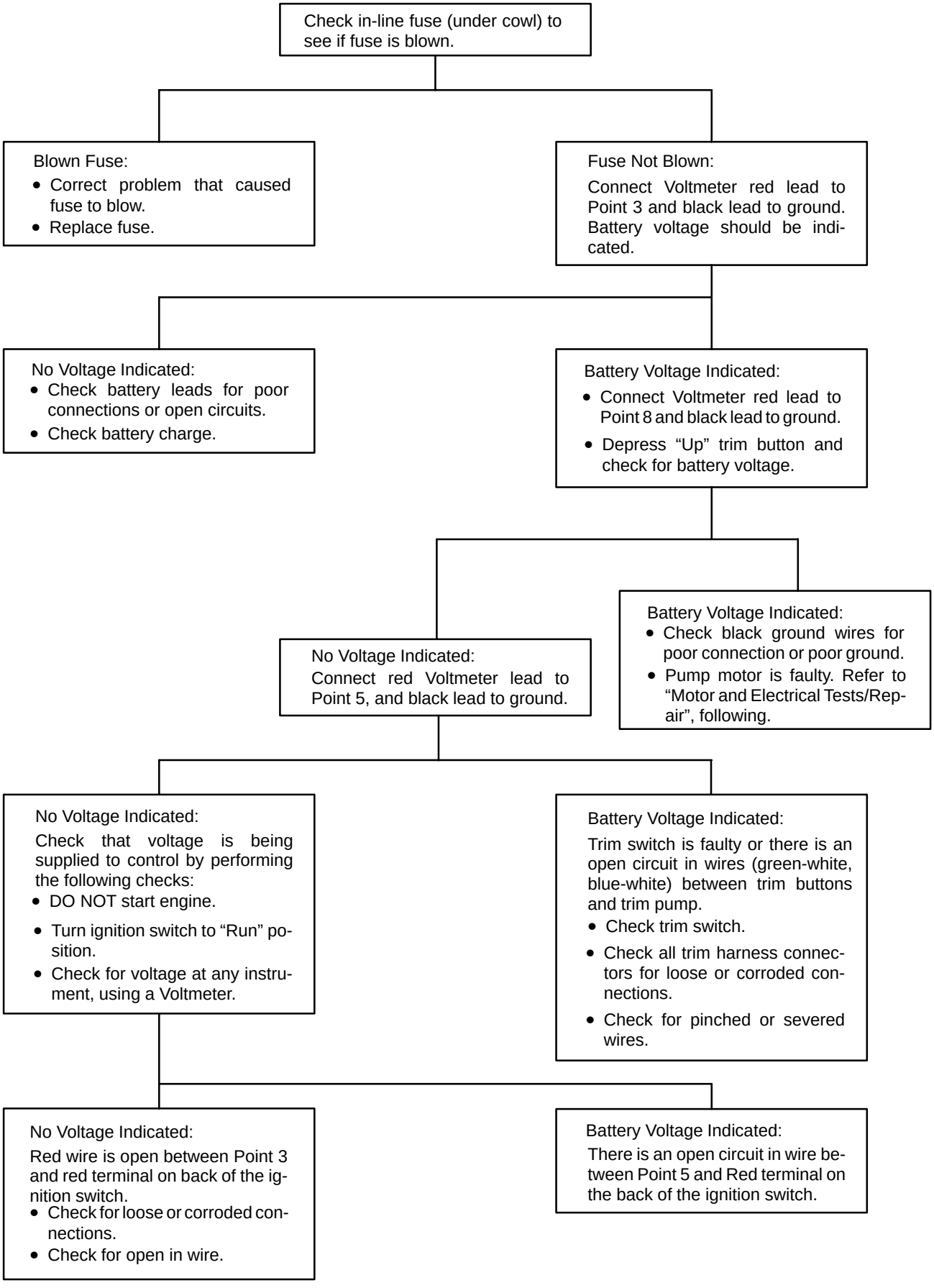
Troubleshooting the “Down” Circuit*
(When “Up” Circuit is OK)


Connect Voltmeter red lead to Point 1 and black lead to ground.
Depress the “Down” trim button.
Battery Voltage Indicated:
Connect Voltmeter red lead to Point 3.
No Voltage Indicated:
Connect Voltmeter red lead to Point 4 and black lead to ground. Depress “Down” trim button. If battery voltage is indicated, wire is open between Points 4 and 1.
Battery Voltage Indicated:
• Connect Voltmeter red lead to Point 2.
• Depress “Down” trim button.
No Voltage Indicated:
There is an open circuit between Point 3 and positive (+) battery terminal.
• Check for loose or corroded connections.
• Check wires for open circuit.
Battery Voltage Indicated:
• Pump motor wiring is defective.
• Pump motor is defective.
No Voltage Indicated:
Relay Switch is defective.
No Voltage Indicated:
Connect Voltmeter red lead to Point 5. If battery voltage is indicated, trim switch is faulty. If no battery voltage, check for loose or corroded connection at Point 5 or open circuit in wire supplying current to Point 5.

Troubleshooting the “Up” Circuit*
(When “Down” Circuit Is OK)


Connect Voltmeter red lead to Point 8 and black lead to ground.
Depress the “Up” trim button.
Battery Voltage Indicated:
Connect Voltmeter red lead to Point 3.
No Voltage Indicated:
Connect Voltmeter red lead to Point 7 and black lead to ground. Depress “Down” trim button. If battery voltage is indicated, wire is open between Points 7 and 8.
Battery Voltage Indicated:
• Connect Voltmeter red lead to Point 6.
• Depress “Up” trim button.
No Voltage Indicated:
There is an open circuit between Point 3 and positive (+) battery terminal.
• Check for loose or corroded connections.
• Check wires for open circuit.
Battery Voltage Indicated:
• Pump motor wiring is defective.
• Pump motor is defective.
No Voltage Indicated:
Relay Switch is defective.
No Voltage Indicated:
Connect Voltmeter red lead to Point 5. If battery voltage is indicated, trim switch is faulty. If no battery voltage, check for loose or corroded connection at Point 5 or open circuit in wire supplying current to Point 5.

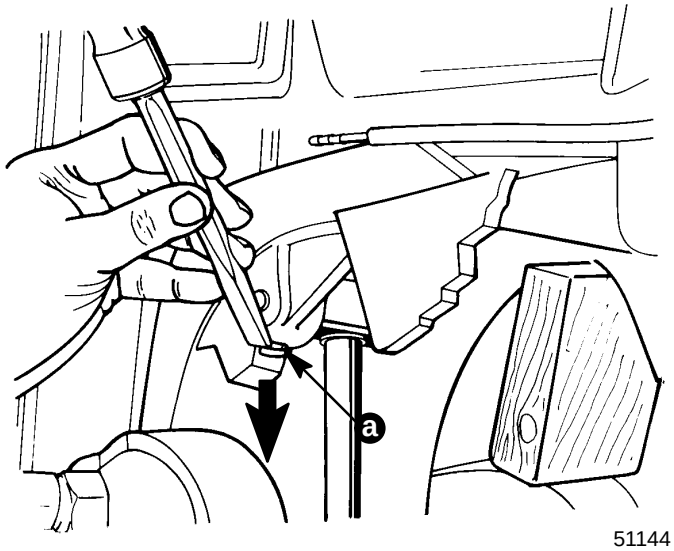
Troubleshooting the “Down” and “Up” Circuits (All Circuits Inoperative)*


Check in-line fuse (under cowl) to see if fuse is blown.
Blown Fuse:
• Correct problem that caused fuse to blow.
• Replace fuse.
Fuse Not Blown:
Connect Voltmeter red lead to Point 3 and black lead to ground. Battery voltage should be indicated.
No Voltage Indicated:
• Check battery leads for poor connections or open circuits.
• Check battery charge.
Battery Voltage Indicated:
• Connect Voltmeter red lead to Point 8 and black lead to ground.
• Depress “Up” trim button and check for battery voltage.
No Voltage Indicated:
Connect red Voltmeter lead to Point 5, and black lead to ground.
Battery Voltage Indicated:
• Check black ground wires for poor connection or poor ground.
• Pump motor is faulty. Refer to “Motor and Electrical Tests/Repair”, following.
No Voltage Indicated:
Check that voltage is being supplied to control by performing the following checks:
• DO NOT start engine.
• Turn ignition switch to “Run” position.
• Check for voltage at any instrument, using a Voltmeter.
Battery Voltage Indicated:
Trim switch is faulty or there is an open circuit in wires (green-white, blue-white) between trim buttons and trim pump.
• Check trim switch.
• Check all trim harness connectors for loose or corroded connections.
• Check for pinched or severed wires.
No Voltage Indicated:
Red wire is open between Point 3 and red terminal on back of the ignition switch.
• Check for loose or corroded connections.
• Check for open in wire.
Battery Voltage Indicated:
There is an open circuit in wire between Point 5 and Red terminal on the back of the ignition switch.

Power Trim System Removal

Support outboard with tilt lock lever when servicing power trim system.

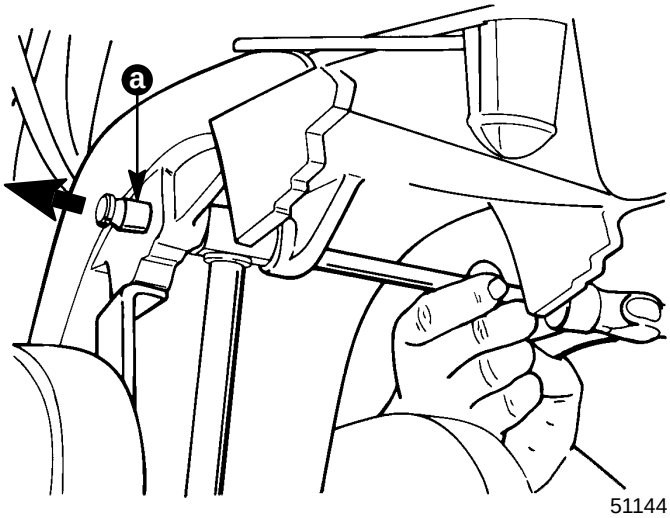
1. Disconnect power trim harness form outboard wiring harness.
2. Remove screw and clip securing wiring harness to clamp bracket.
3. Use suitable tool to remove (DRIVE DOWN) upper dowel pin. Retain pin.



51144

a - Dowel Pin

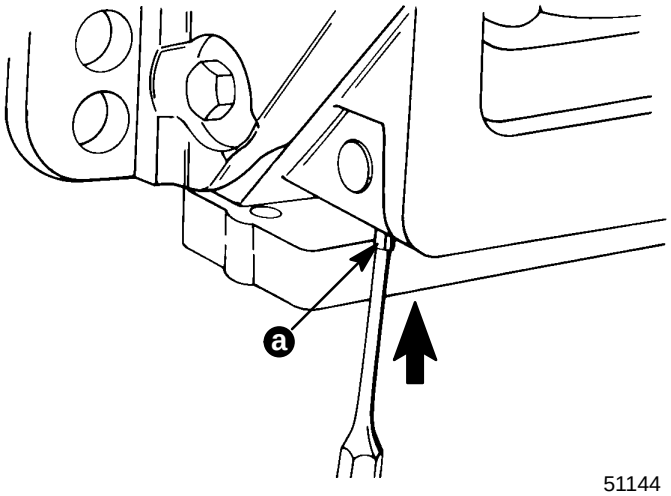
4. Use suitable punch to drive out upper pivot pin.



51144

a - Pivot Pin

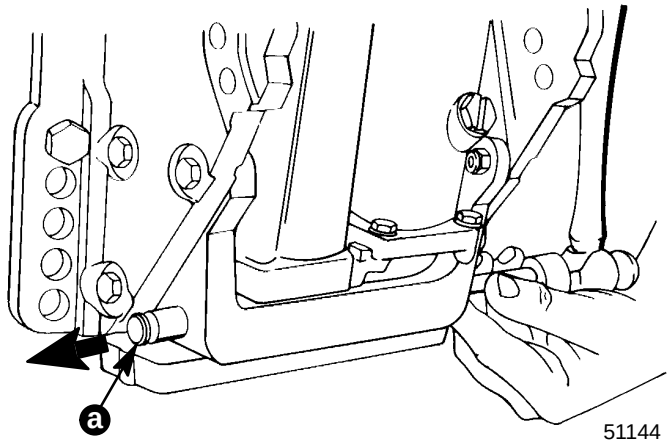
5. Use suitable punch to remove (DRIVE UP) lower dowel pin. Retain dowel pin.



51144

a - Dowel Pin

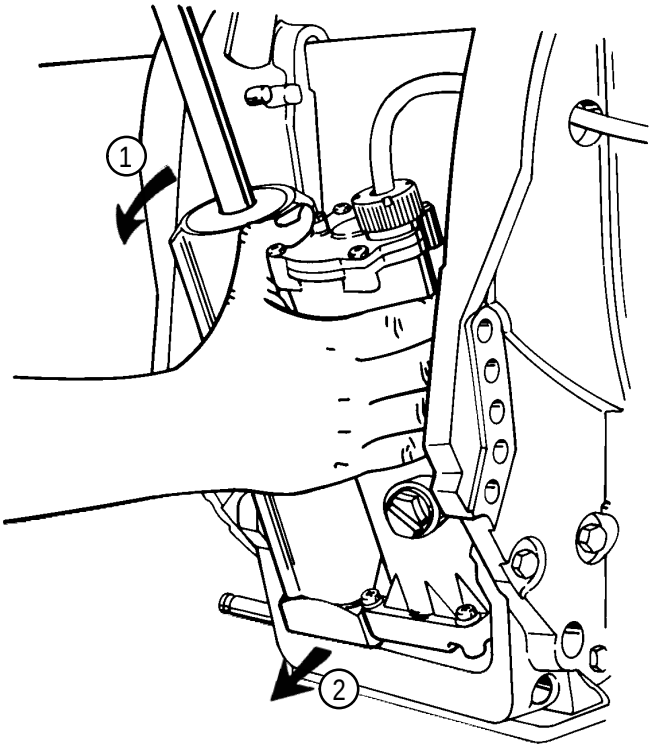
6. Use suitable punch to drive out lower pivot pin.



51144

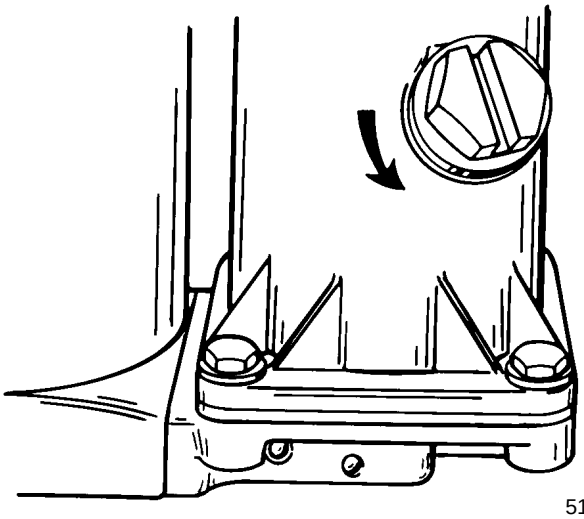
a - Pivot Pin

7. Tilt power trim assembly (top first) out from clamp bracket and remove assembly.



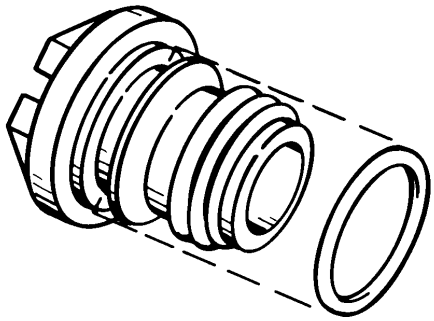
51195

8. Remove fill cap and drain unit.



51193

9. Remove O-ring from fill cap.



51194

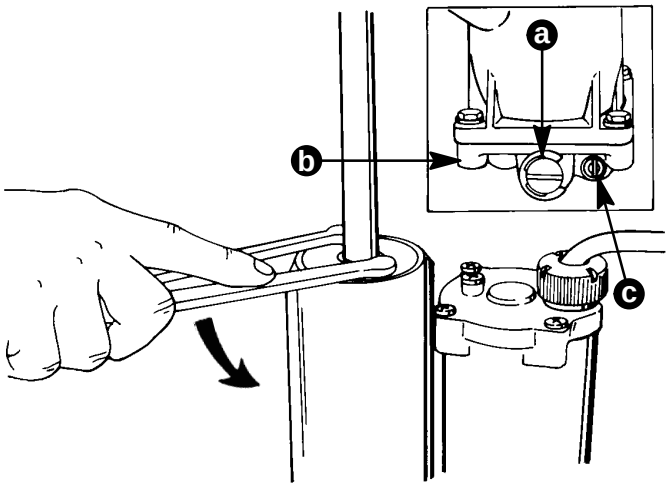
Power Trim System Disassembly

Trim Rod Removal

⚠ CAUTION

DO NOT ADJUST OR REMOVE REVERSE THRUST VALVE. THIS VALVE IS PRESET AT FACTORY FOR PRECISE REVERSE THRUST PRESSURE AND DOES NOT REQUIRE ADJUSTMENT.

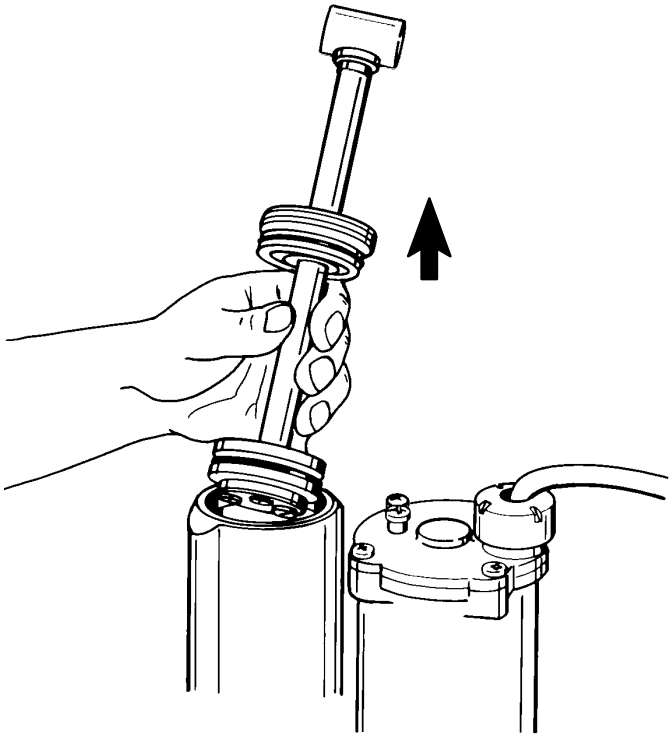
1. Secure power trim assembly in soft jawed vise.
2. Open manual release valve three or four turns (counterclockwise) and position trim rod to full up position.
3. Remove cylinder end cap assembly from cylinder using trim cylinder spanner wrench (1/4 in. x 5/16 in. long pegs).



51194

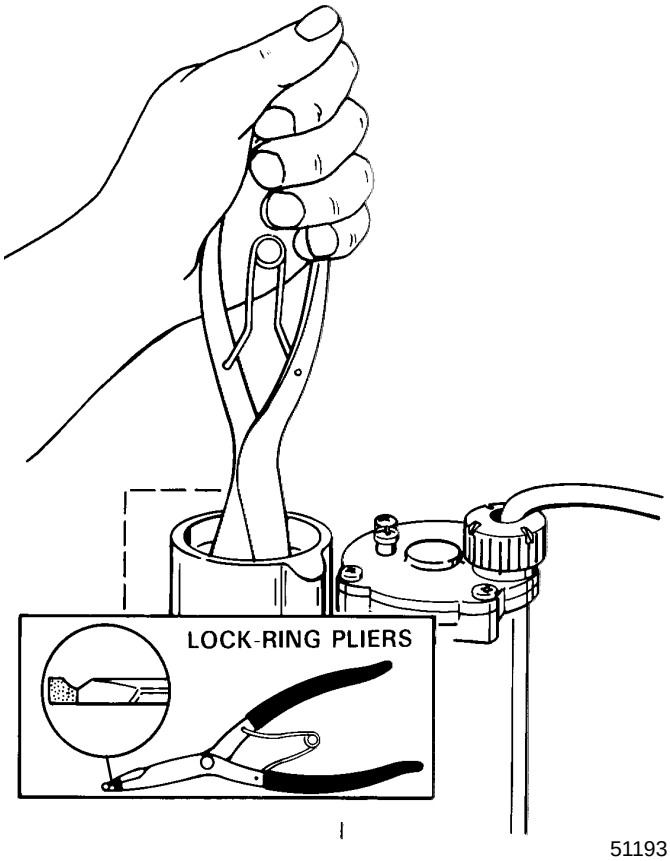
a - Manual Release Valve
b - Manifold
c - Reverse Thrust Valve (Do Not Remove, or Adjust)

4. Remove trim rod assembly from cylinder.



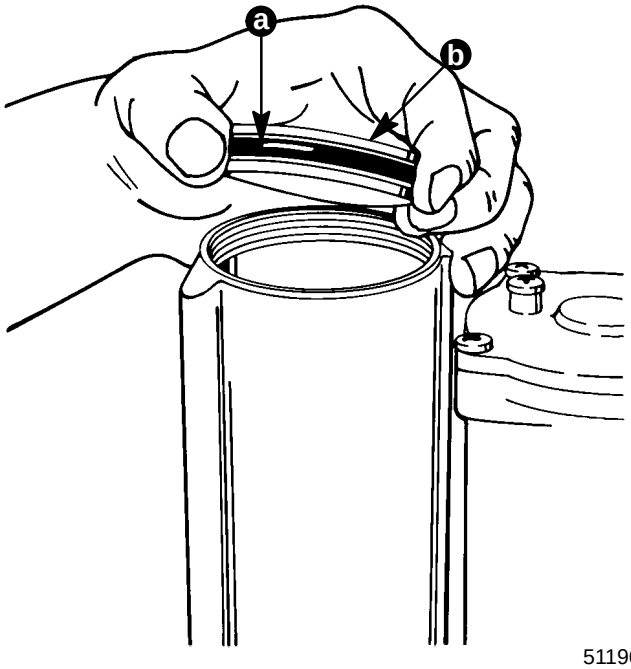
51196

5. Remove memory piston from cylinder using lock-ring pliers (Craftsman P/N 4735) or suitable tool.



51193

6. Remove O-ring from memory piston.



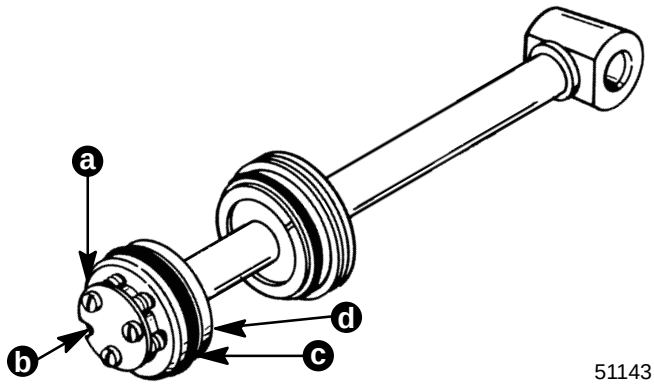
51196

a - O-ring
b - Memory Piston

7. Remove trim system from vise and empty fluid into appropriate container.

Trim Rod Disassembly

1. Place trim rod assembly on clean work surface.
2. Remove screws securing plate to trim rod piston and O-ring.
3. Remove check valve components from trim rod piston.



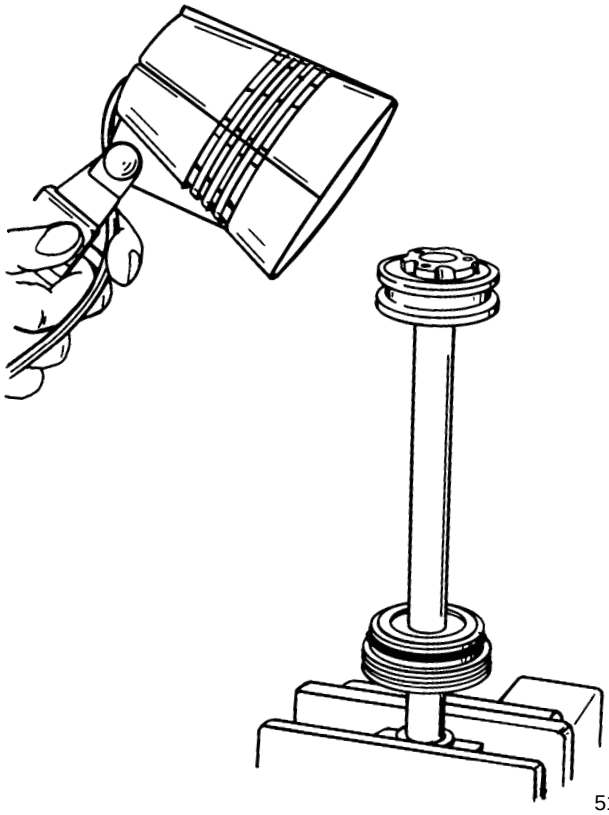
51143

a - Screw (3)
b - Plate
c - O-ring
d - Piston

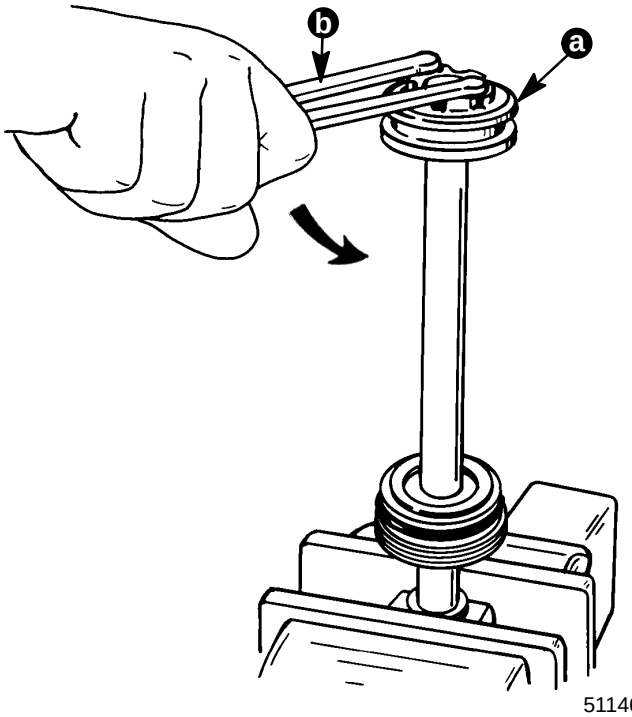
⚠ CAUTION

When removing Trim Rod piston, spanner wrench must have 1/4 in. x 5/16 in. long pegs to avoid damage to trim piston.

4. Place trim rod into soft jawed vise and apply heat to loosen piston using torch lamp (P/N 91-63209).
5. Loosen trim rod piston using trim spanner spanner wrench (1/4 in. x 5/16 in. long pegs).
6. Allow trim rod piston to cool, remove from trim rod.



51146



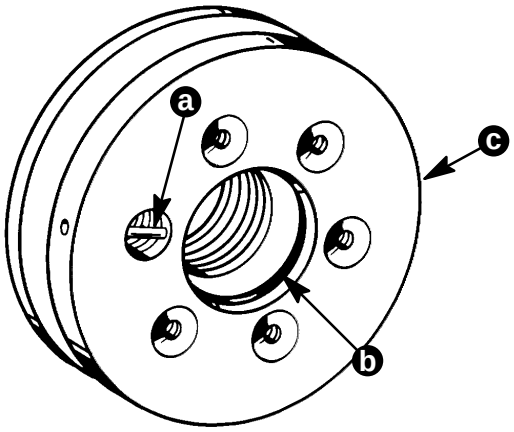
51146

a - Trim Rod Piston
b - Spanner Wrench

⚠ CAUTION

Do not remove check ball components from trim rod piston. Removal and re-installation of check valve could result in improper operating pressure and possible power trim system damage. If check valve is defective, replace trim rod piston.

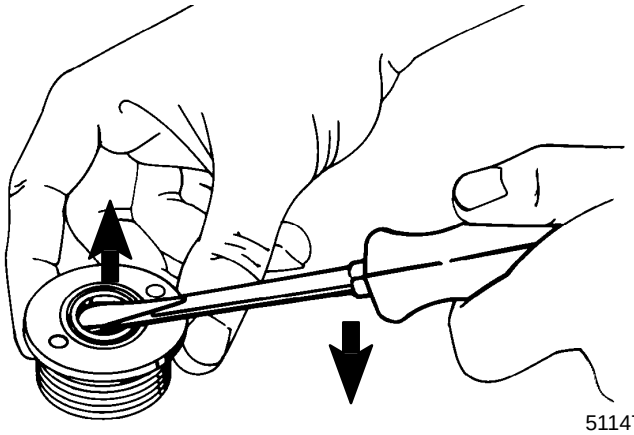
7. Remove inner O-ring from piston.



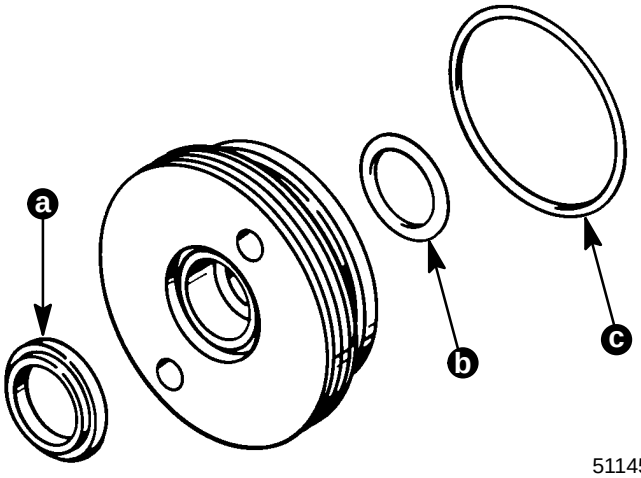
51199

a - Check Ball Components
b - O-ring
c - Piston

8. Remove rod wiper, inner O-ring and outer O-ring.



51147

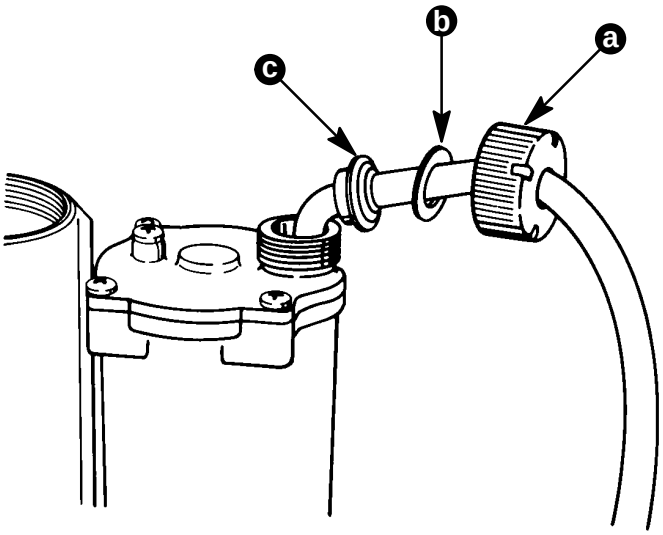


51145

a - Rod Wiper
b - Inner O-ring
c - Outer O-ring

Trim “Motor” Removal

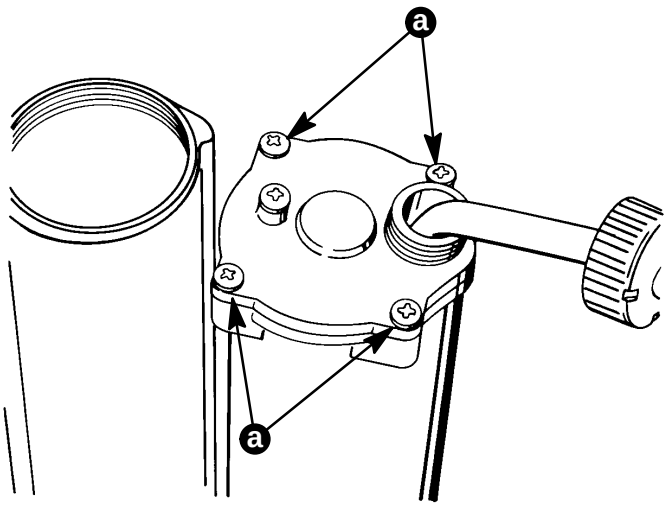
1. Secure power trim assembly in soft jawed vise.
2. Remove cap, washer and grommet from reservoir assembly.



51195

a - Cap
b - Washer
c - Grommet

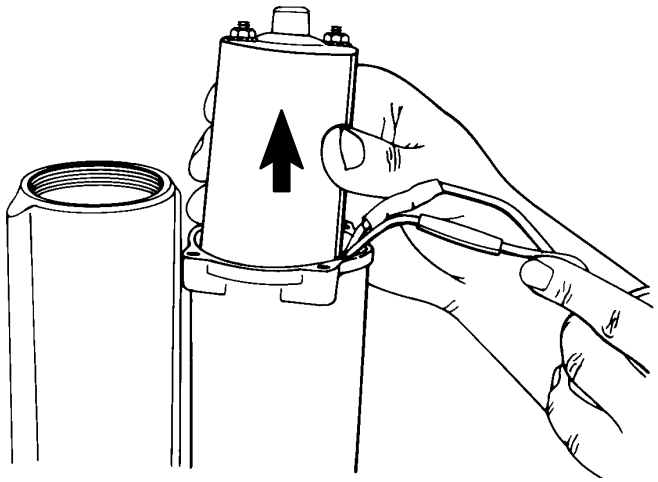
3. Remove screws securing reservoir cap to reservoir.



51193

a - Screws (4)

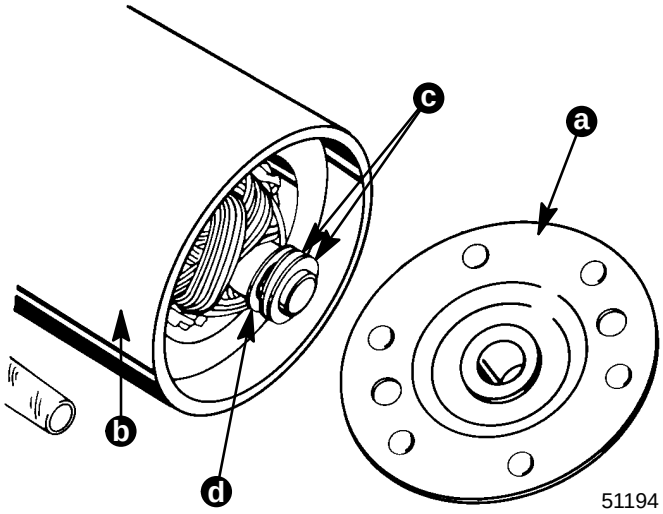
4. Remove motor harness from reservoir.



51196

Trim Motor Disassembly

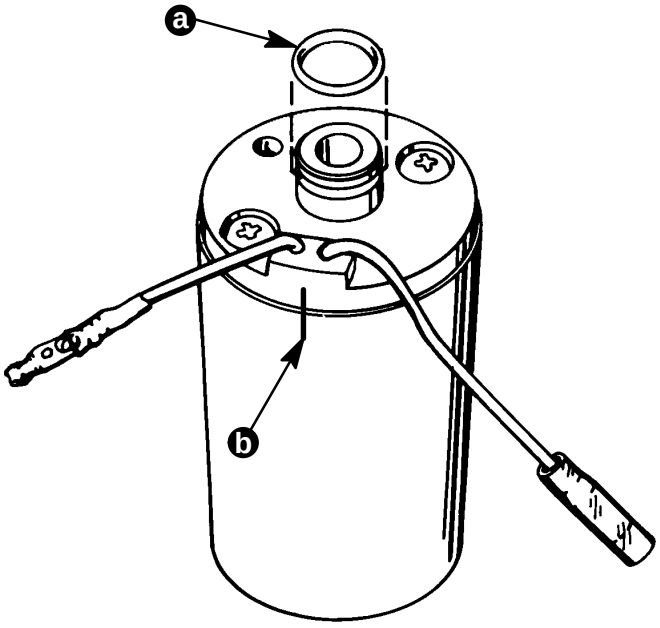
1. Remove end cap from motor housing. Note position of washers on armature.



51194

a - End Cap
b - Motor Housing
c - Wave Washer (2)
d - Washer

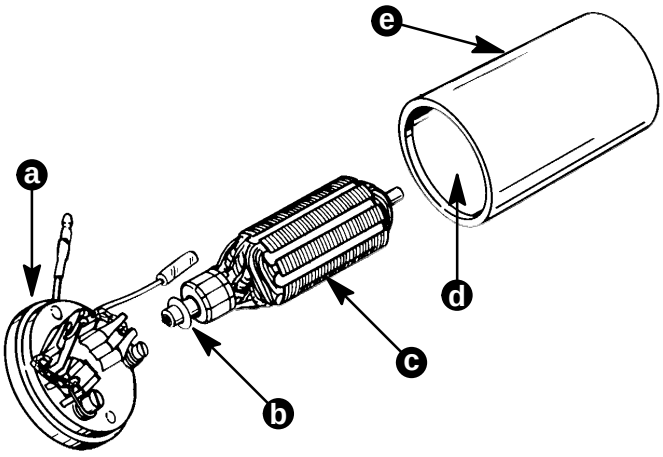
2. Remove O-ring from end frame.
3. Place scribe mark on motor housing and end frame as re-assembly reference, as shown.



51194

a - O-ring
b - Scribe Mark

4. Remove end frame and armature from housing.



51194

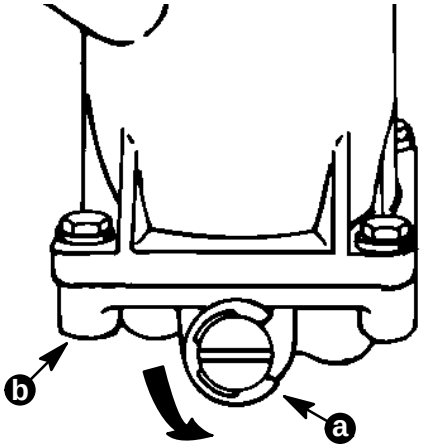
a - End Frame
b - Washer
c - Armature
d - Fiber Guard (Liner)
e - Housing

Reservoir Assembly Removal

⚠ CAUTION

DO NOT ADJUST OR REMOVE REVERSE THRUST VALVE. THIS VALVE IS PRESET AT FACTORY FOR PRECISE REVERSE THRUST PRESSURE AND DOES NOT REQUIRE ADJUSTMENT.

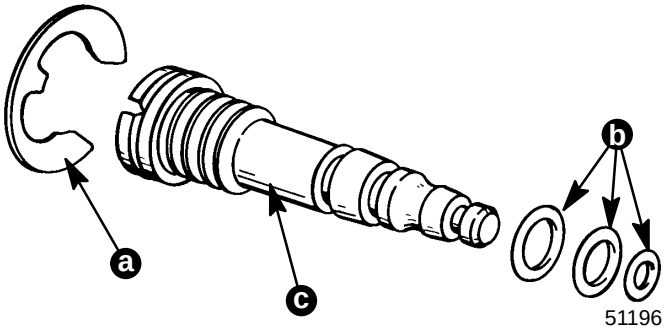
1. Remove manual release valve form manifold. **DO NOT** remove or adjust reverse thrust valve.



51194

a - Manual Release Valve
b - Manifold

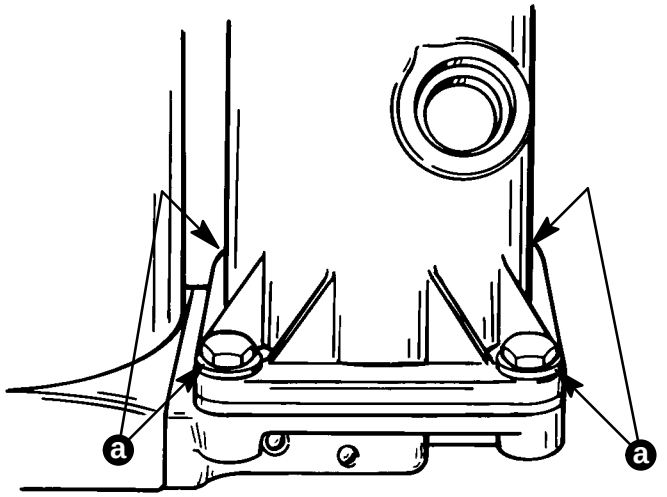
2. Remove “E” clip and O-rings from manual release valve.



51196

a - “E” Clip
b - O-rings
c - Manual Release Valve

3. Remove four screws securing reservoir to manifold.

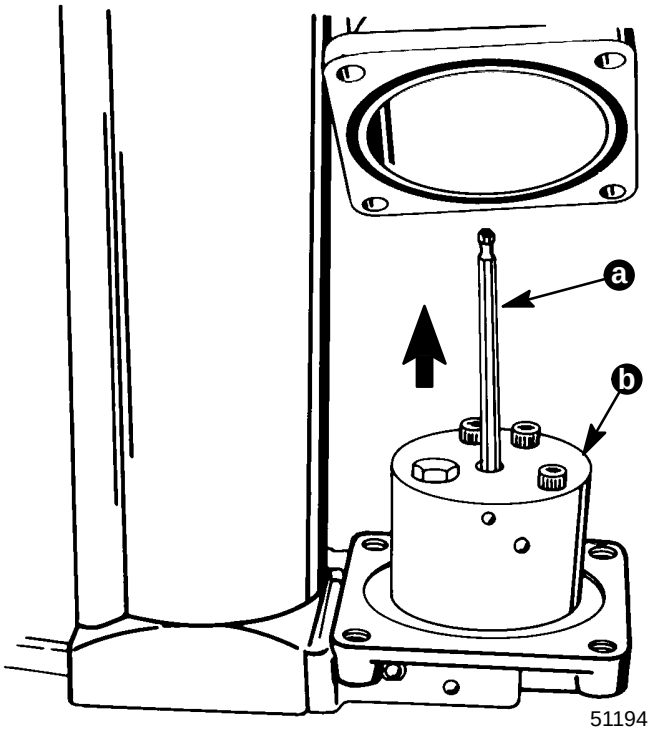


51193

a - Screws (4)

4. Remove reservoir from manifold.

5. Remove drive shaft from oil pump.

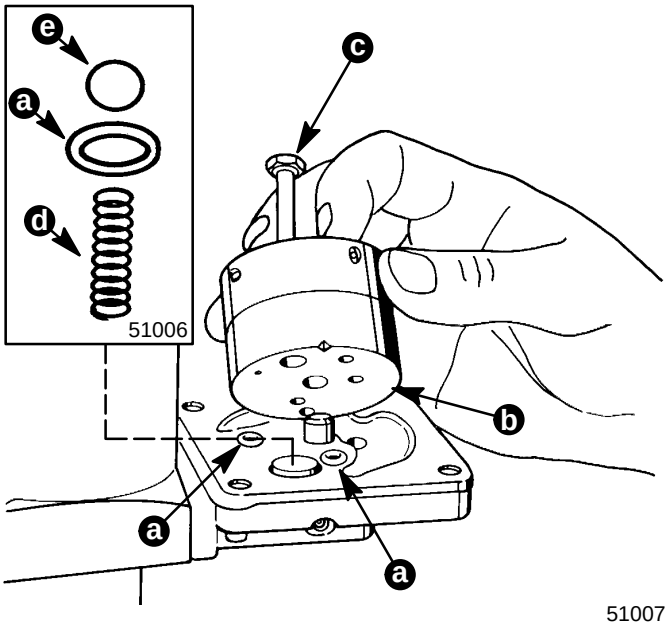


51194

a - Drive Shaft
b - Oil Pump

Oil Pump/Manifold Removal

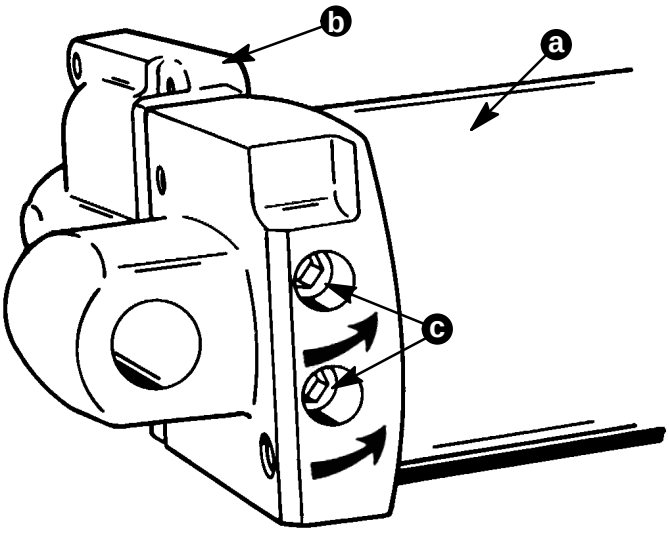
1. Remove screw, oil pump, O-rings and check valve components from manifold.



51007

a - O-rings (3)
b - Oil Pump
c - Screw
d - Spring
e - Check Ball

2. Remove screws and manifold from cylinder.

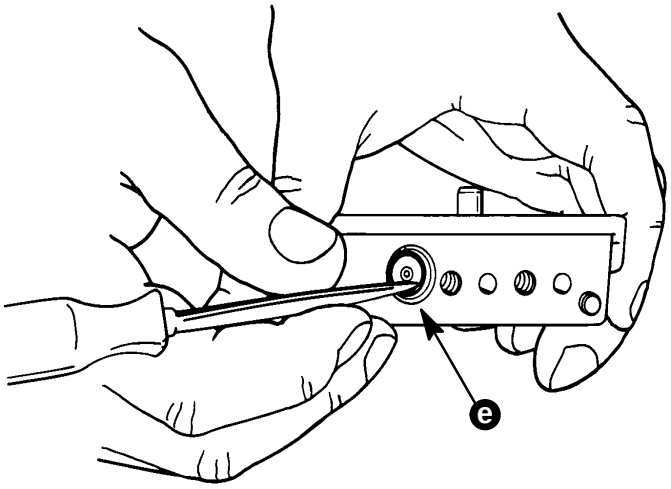


51007

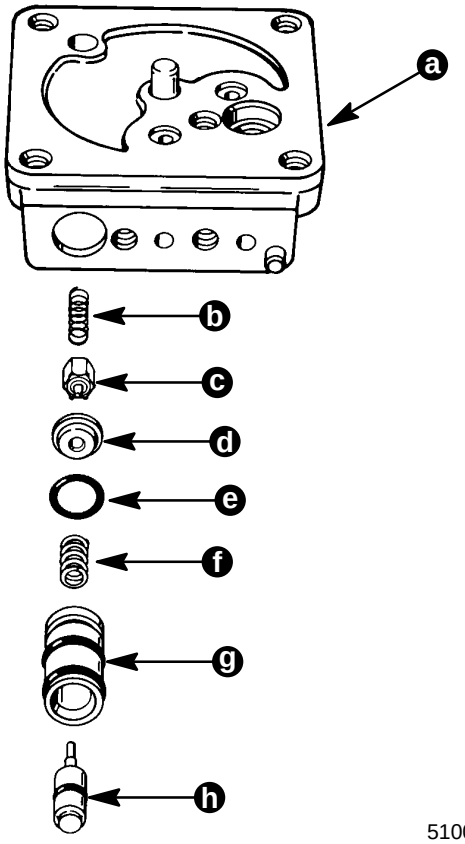
a - Trim Cylinder
b - Manifold
c - Screw

IMPORTANT: Removal of O-ring (e) from manifold will result in damage to O-ring. O-ring MUST be replaced after removal.

3. Remove check valve components from manifold.



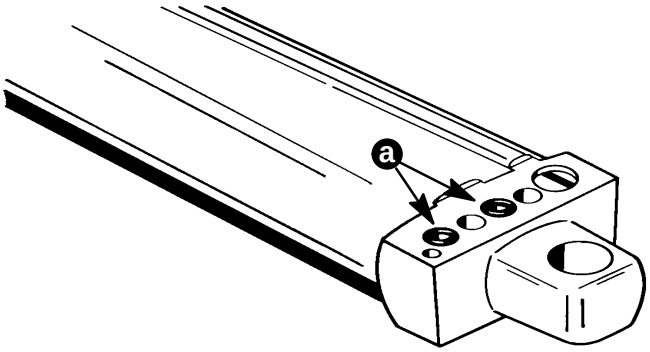
51736



51008

a - Manifold
b - Spring
c - Check Valve
d - Check Valve Seat
e - O-ring
f - Spring
g - Sleeve
h - Spool

4. Remove O-rings from cylinder.



51008

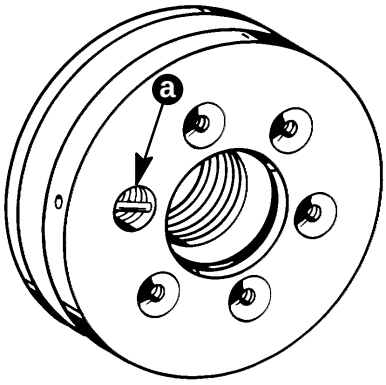
a - O-rings

Cleaning and Inspection of Trim Rod Components

IMPORTANT: Components must be dirt and lint free. Slightest amount of debris in Power Trim system could cause system to malfunction.

⚠ CAUTION

Do not remove check valve components (a) from trim rod piston. Removal and re-installation of check valve could result in improper operating pressure and possible power trim system damage.



51199

Inspect check valve for debris; clean debris form check valve if found. If debris cannot be cleaned from check valve, replace trim rod piston as an assembly.

Clean trim rod and components with parts cleaner and dry with compressed air.

It is recommended that all O-rings in trim system be replaced.

Inspect trim rod. If scraper (located in cap) has failed to keep rod clean, replace scraper.

Lubricate all O-rings using Quicksilver Power Trim and Steering Fluid or; (ATF) Type F, FA or Dexron II.

Motor and Electrical Tests/ Repair

Trim Pump Motor Test

⚠ WARNING

Do not perform this test near flammables (or explosives), as a spark may occur when making connections.

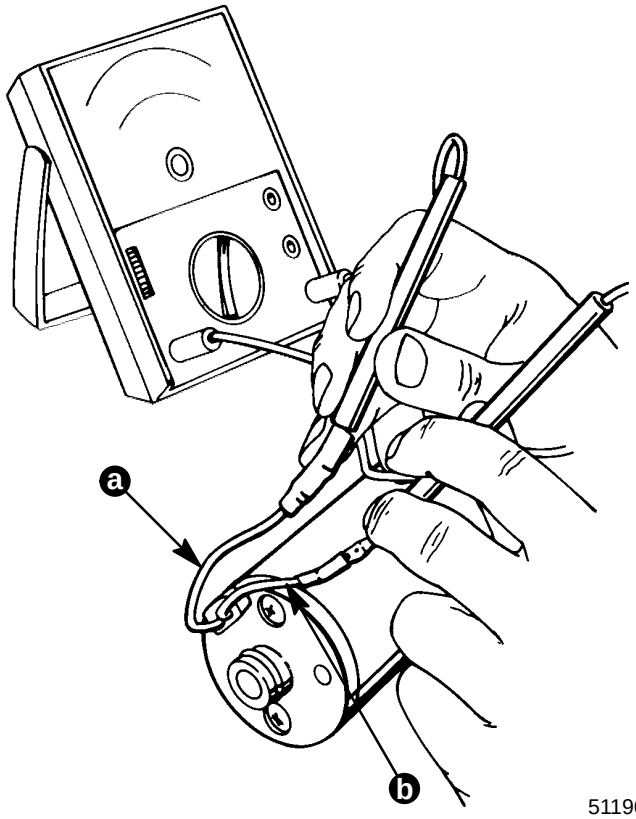
1. Disconnect orange (motor) wire and black (motor) wire from relay switch wiring harness.
2. Connect a 12 volt power supply to motor wires (positive to orange; negative to black results in motor up direction. Positive to black; negative to orange results in motor down direction). Motor should run.
3. If motor does not run, disassemble motor and check components.

Thermal Overload Switch Test

IMPORTANT: If thermal overload switch has been activated, pump motor cannot be tested for a minimum of one minute. After this period switch should close (reset itself) and pump motor may be operated. Perform the following check(s) only if switch does not reset itself.

MOTOR ASSEMBLED

Connect Ohmmeter (R x 1 scale) leads as shown. If switch is good, full continuity (zero ohms) will be indicated. If full continuity is not indicated, disassemble motor and recheck switch per instructions, following.

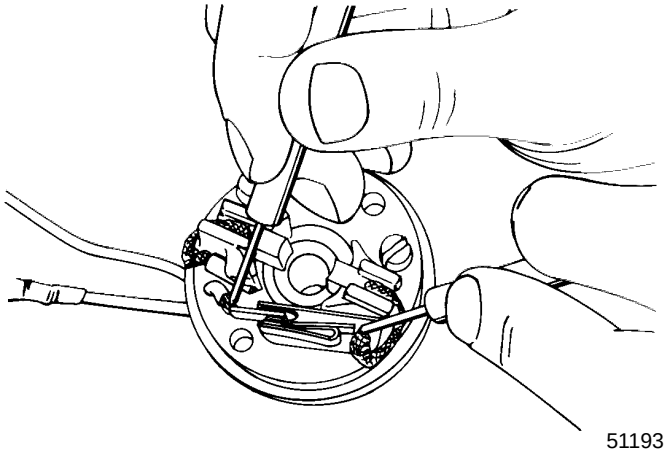


51196

a - Motor Wire (Black)
b - Motor Wire (Orange)

MOTOR DISASSEMBLED

Connect Ohmmeter (R x 1 scale) leads as shown. If switch is good, full continuity (zero ohms) will be indicated.



51193

If full continuity is not indicated, clean switch contact surfaces, using an ignition point file.

Recheck switch; if full continuity is not indicated, replace end frame.

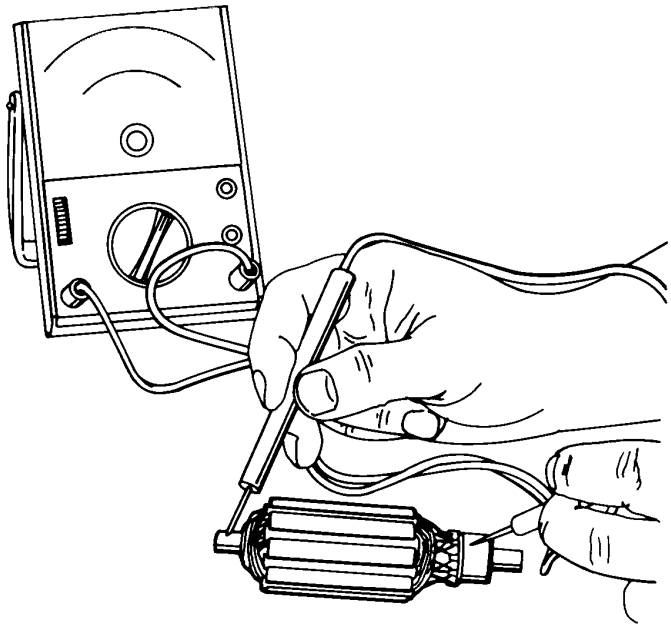
Armature Tests

TEST FOR SHORTS

Check armature on a Growler (follow Growler manufacturer's test instructions). Indication of a short requires replacement of armature.

TEST FOR GROUND

Use an Ohmmeter (R x 1 scale). Place one lead on Ohmmeter on armature shaft and other lead on commutator, as shown. If continuity is indicated, armature is grounded and must be replaced.

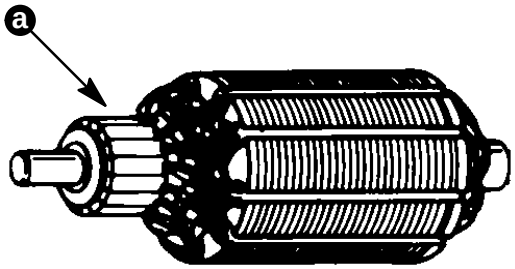


51195

CHECKING AND CLEANING COMMUTATOR

If commutator (a) is worn it can be turned down on an armature conditioner tool or on a lathe.

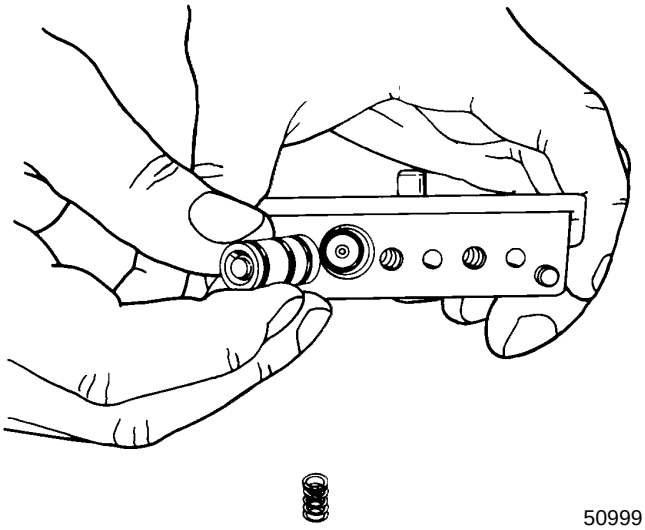
Clean commutator with "00" sandpaper.



Power Trim System Reassembly

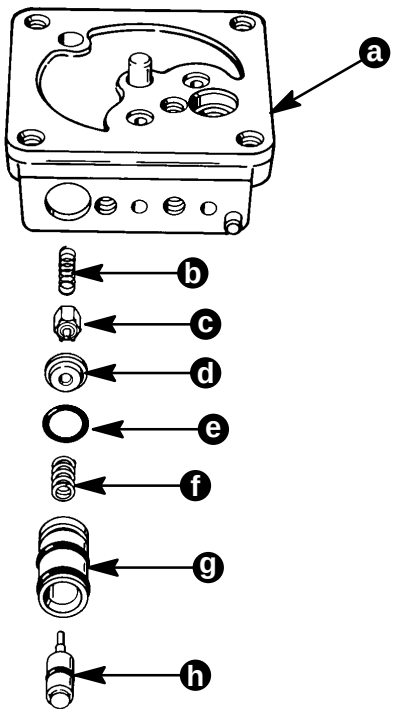
Manifold/Oil Pump Installation

IMPORTANT: Install spring, check valve and O-ring into manifold. Position components in place using sleeve to seat in place.



50999

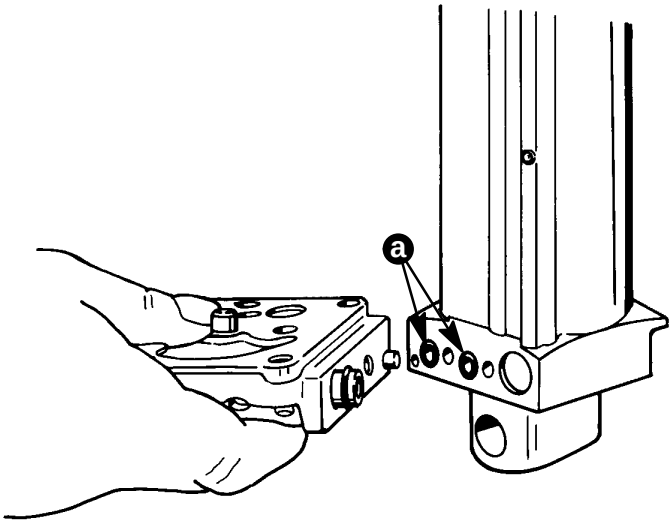
1. Install check valve components into manifold.



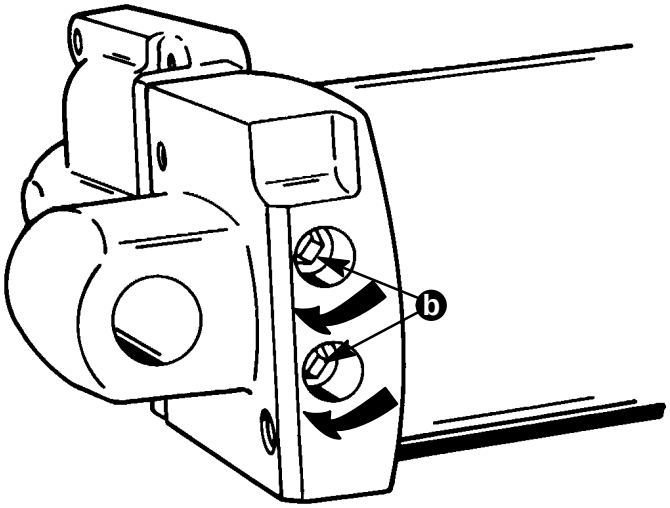
51008

a - Manifold
b - Spring
c - Check Valve
d - Check Valve Seat
e - O-ring
f - Spring
g - Sleeve
h - Spool

2. Install O-rings on cylinder and secure manifold assembly to cylinder using screws. Torque screws to 100 lb. in. (11.3 N·m).



51008

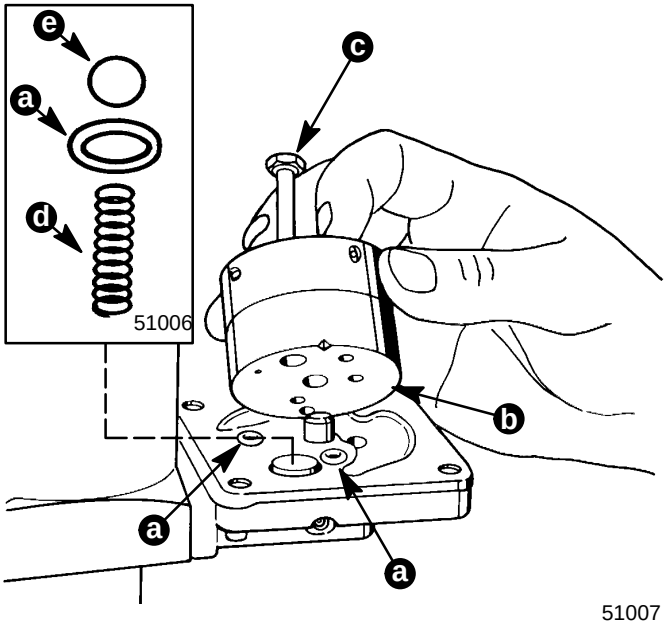


51007

a - O-ring
b - Screws [100 lb. in. (11.3 N·m)]

3. Secure power trim unit in soft jawed vise.

4. Install check valve components and O-rings to manifold. Secure oil pump to manifold using bolt. Torque bolt to 90 lb. in. (10.2 N·m).

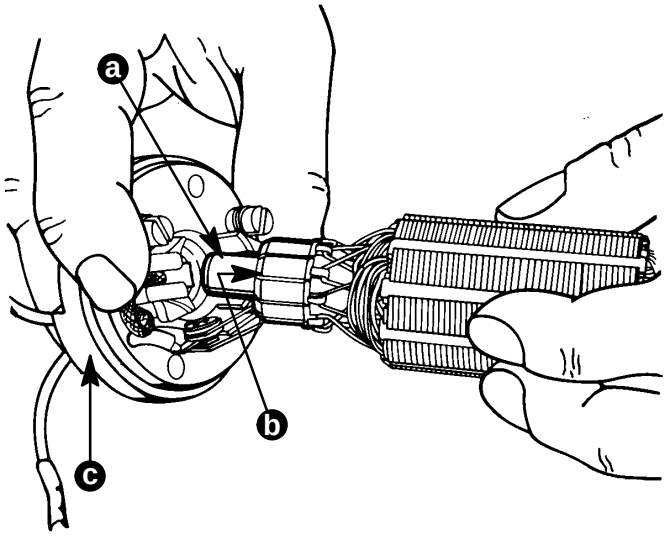


51007

a - O-rings (3)
b - Oil Pump
c - Screw
d - Spring
e - Check Ball

Trim Motor Reassembly

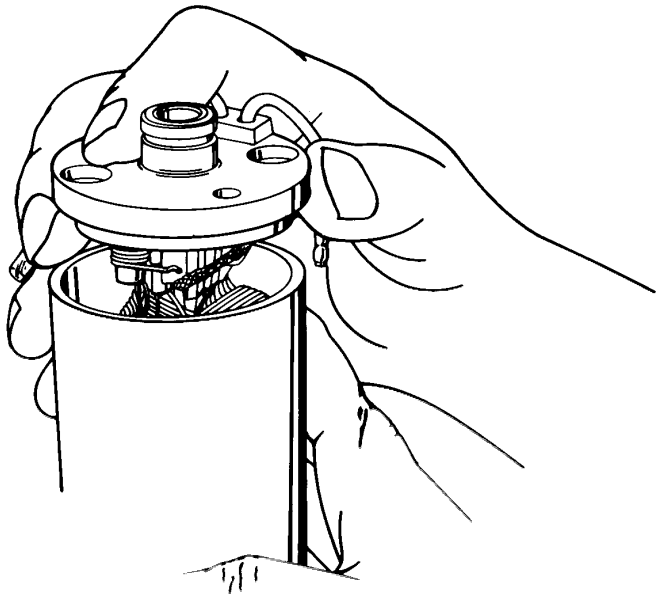
1. Apply Quicksilver Marine Lubricant (2-4-C) to armature shaft and insert into end frame.



51195

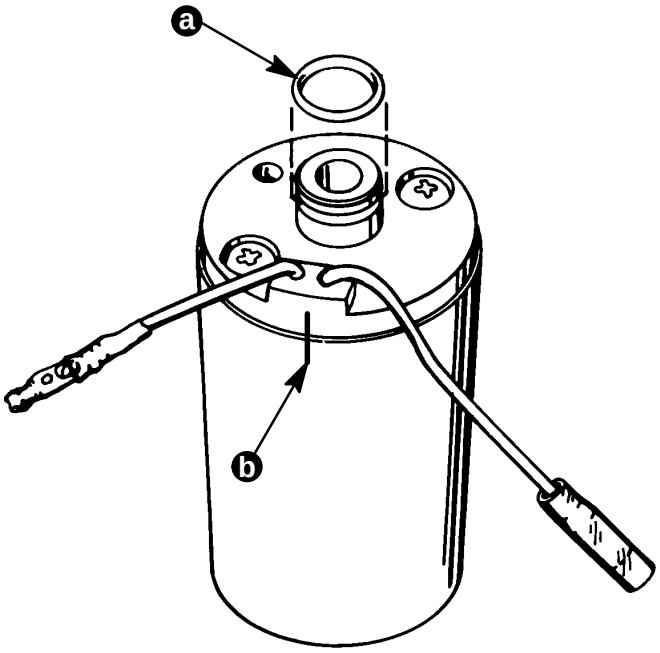
a - Armature Shaft
b - Washer
c - End Frame

2. Guide armature and end frame into housing as shown.



51196

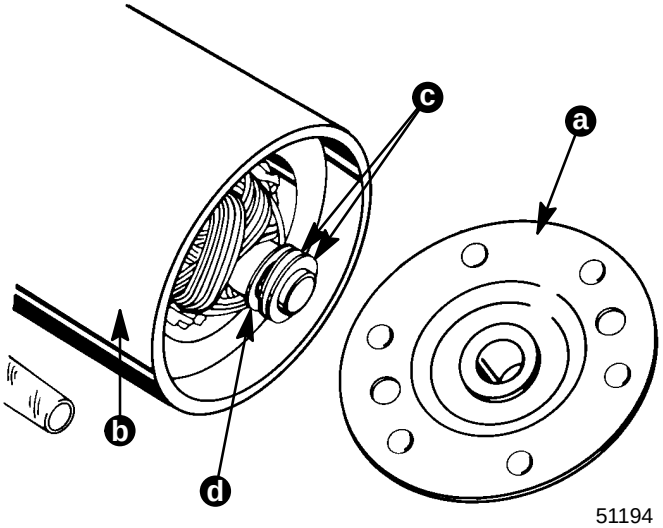
3. Align scribe mark on housing to mark on end frame.
4. Install lubricated O-ring to end frame.



51194

a - O-ring
b - Scribe Mark

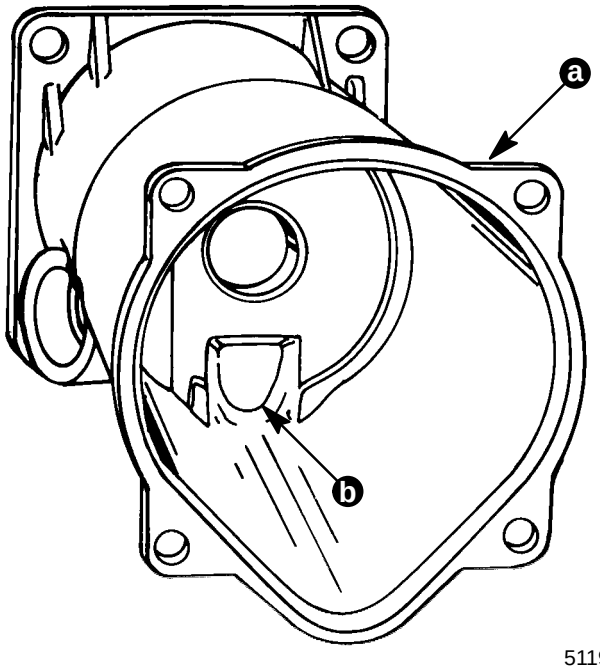
5. Install washers to armature shaft as shown.
6. Install end cap to housing. Torque nuts to 25 lb. in. (2.8 N·m).



51194

a - End Cap
b - Motor Housing
c - Wave Washer
d - Washer

IMPORTANT: When installing motor, wires (black, orange) must rest in cavity of cylinder allowing motor to seat properly.

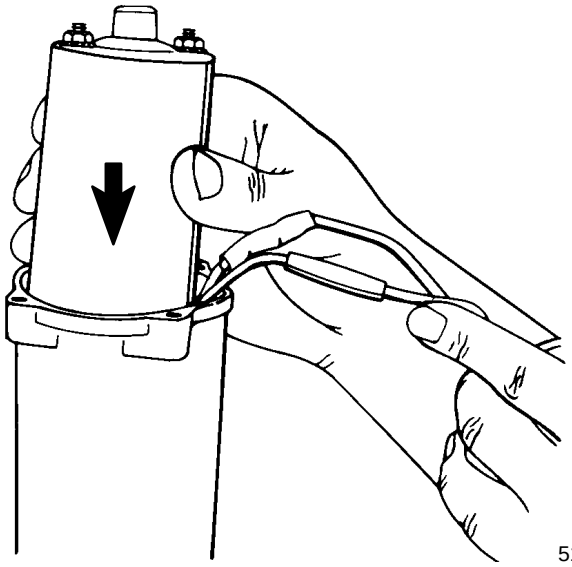


51194

a - Manifold
b - Cavity

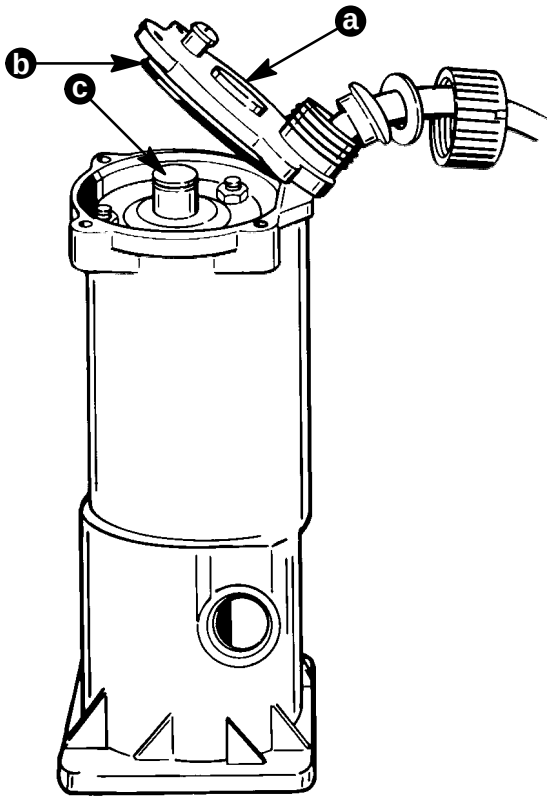
Reservoir Installation

1. Connect trim motor wires to harness.
2. Insert motor into reservoir. Motor must be seated properly prior to end cap installation.



51196

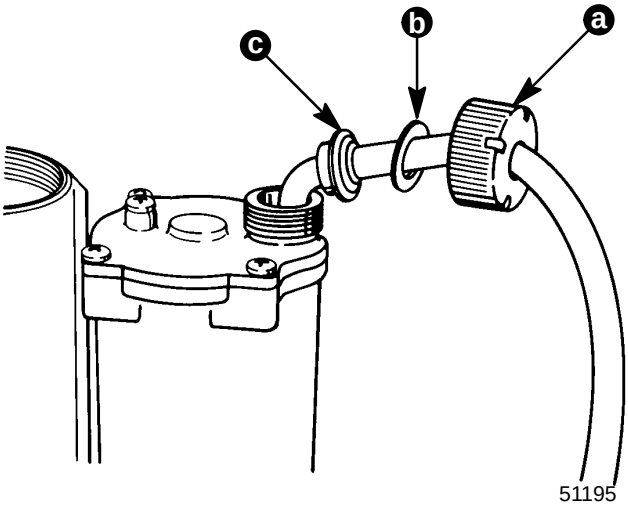
3. Install end cap, O-ring and foam pad to cylinder.
4. Torque screws to 13 lb. in. (1.5 N·m).



51195

a - End Cap
b - O-ring
c - Foam Pad

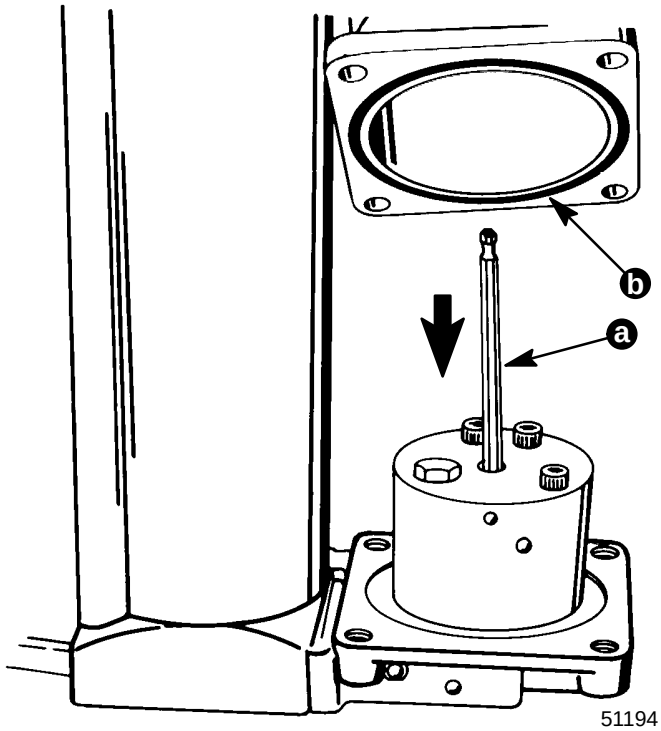
5. Install grommet, washer and screw cap to cylinder end cap. Tighten screw securely.



51195

a - Screw Cap
b - Washer
c - Grommet

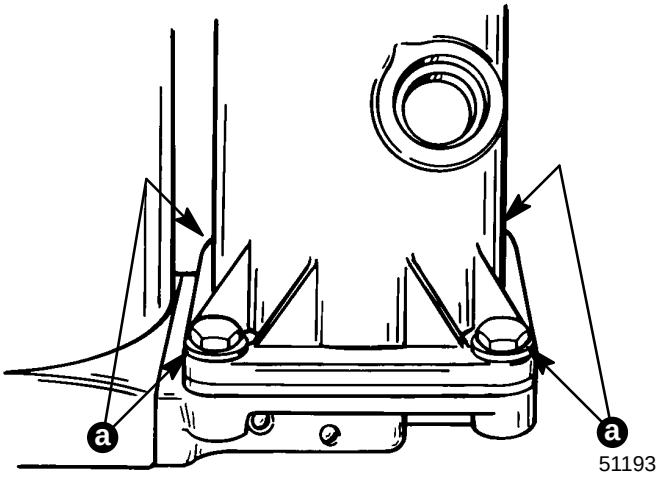
6. Place drive shaft into oil pump.
7. Install lubricated O-ring to base of reservoir.
8. Carefully guide (cylinder/motor) down onto drive shaft.



51194

a - Drive Shaft
b - O-ring

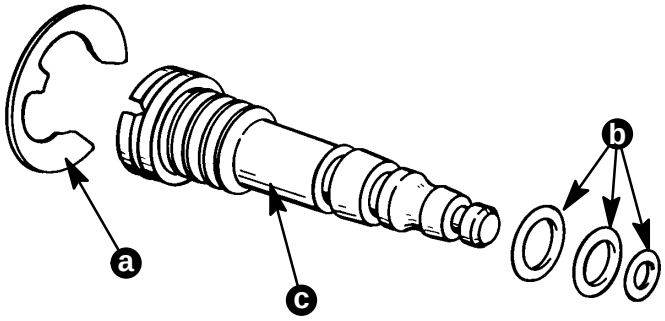
9. Secure reservoir to manifold using four screws. Torque screws to 70 lb. in. (7.7 N·m).



51193

a - Screw

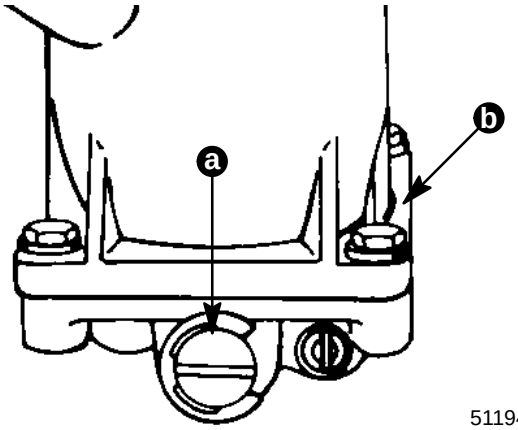
10. Install “E” clip, lubricated O-rings and to manual release valve.



51196

a - “E” Clip
b - O-ring
c - Manual Release Valve

11. Insert manual release valve into manifold and tighten snuggly. Back release valve out 3 or 4 turns allowing trim rod installation.

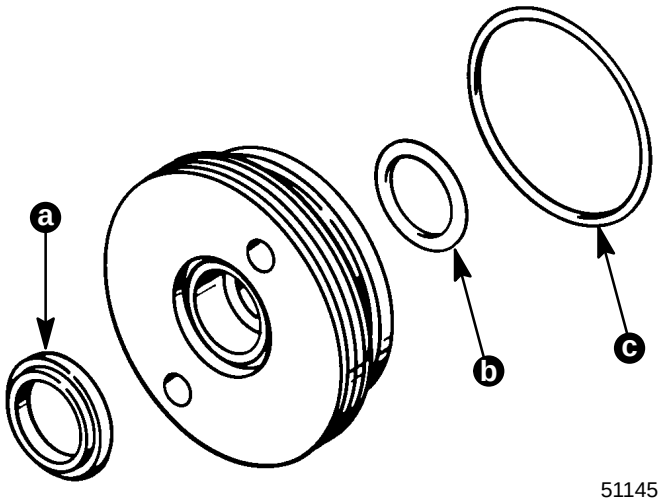


51194

a - Manual Release Valve
b - Manifold

Trim Rod Reassembly

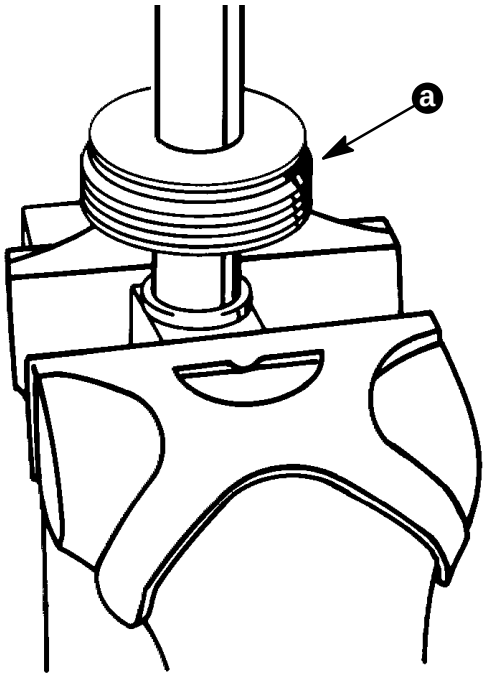
1. Install lubricated O-rings and rod wiper to end cap.



51145

a - Rod Wiper
b - Inner O-ring
c - Outer O-ring

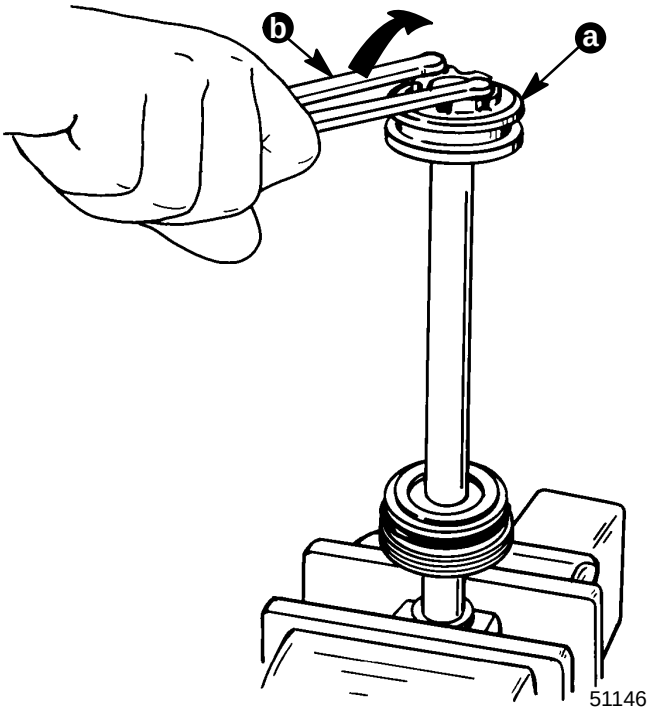
2. Secure trim rod in soft jawed vise as shown.
3. Slide end cap onto trim rod.



51146

a - End Cap

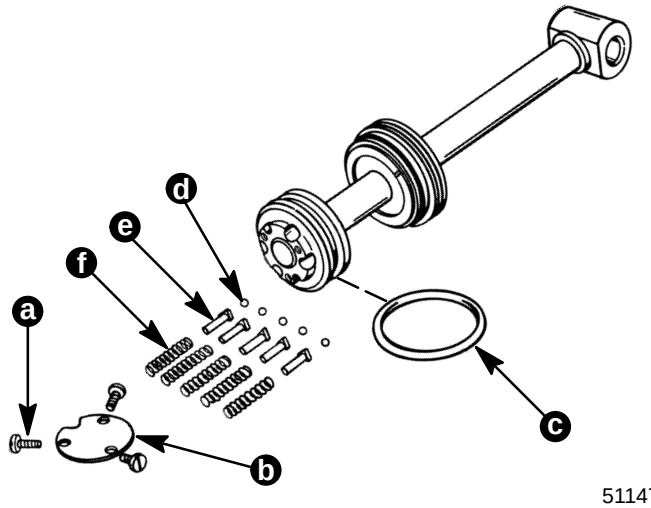
4. Apply Loctite Grade A (271) to threads of trim rod and install rod piston. Tighten piston securely using trim cylinder spanner wrench (1/4 in. x 5/16 in. long peg).



51146

a - Trim Rod Piston
b - Spanner Wrench

5. Install lubricated O-ring to trim rod piston.
6. Install check valve components into their respective seats.
7. Secure components in place using plate and screws. Torque screws to 35 lb. in. (4.0 N·m).

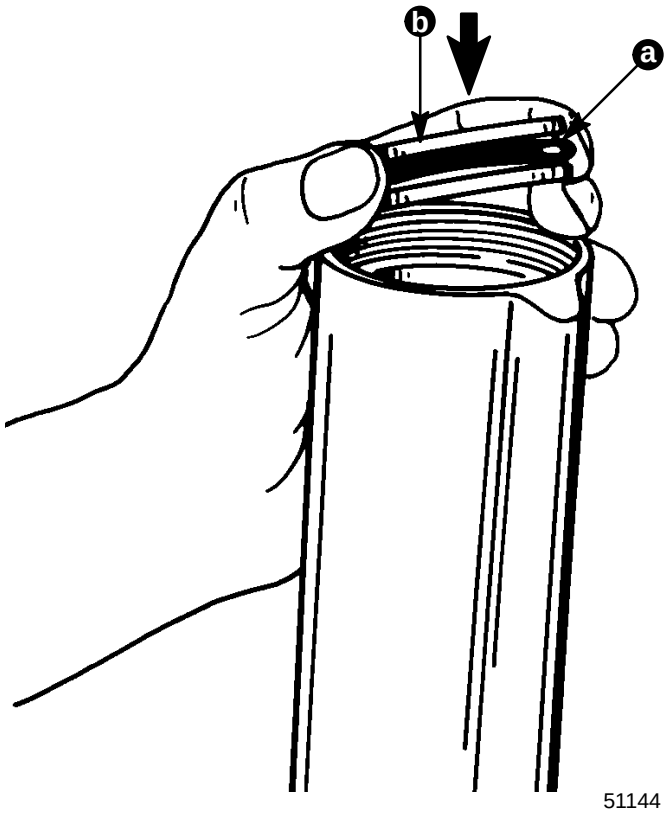


51147

a - Screw (3)
b - Plate
c - O-ring
d - Ball (5)
e - Seat, Spring (5)
f - Spring (5)

Trim Rod Installation

1. Place trim cylinder in soft jawed vise.
2. Fill trim cylinder three inches (76.2mm) from top of cylinder using Quicksilver Power Trim and Steering Fluid or; (ATF) Type F, FA or Dexron II.
3. Install lubricated O-ring to memory piston and place into cylinder. Push piston down to level of oil.

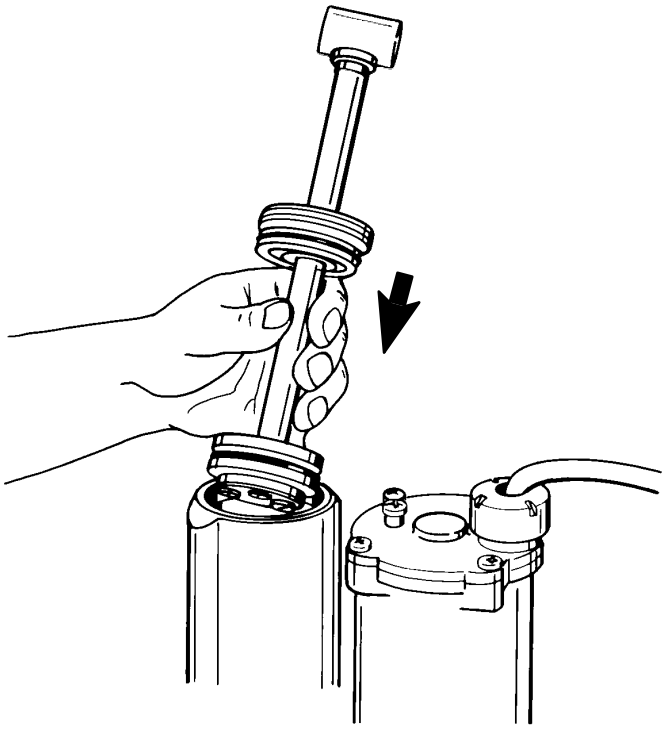


51144

a - O-ring
b - Memory Piston

IMPORTANT: Memory piston must not come in contact with trim rod end cap during end cap/trim rod installation.

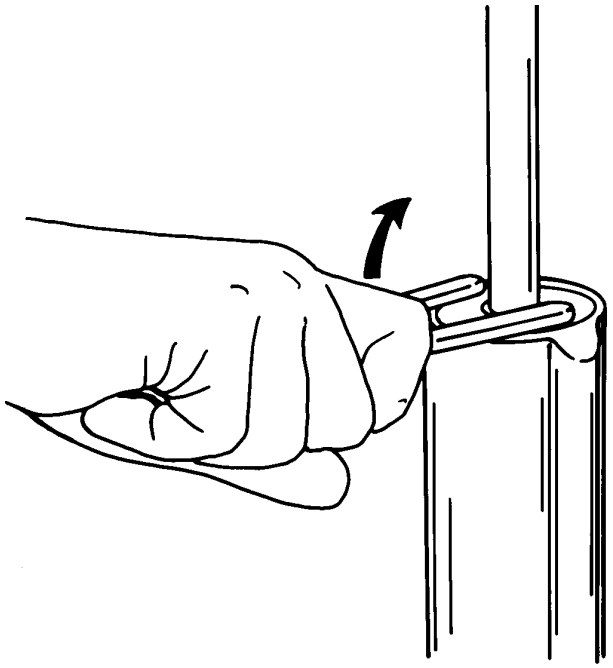
4. Install trim rod into cylinder.



51196

IMPORTANT: Memory piston must not come in contact with trim rod end cap during end cap/trim rod installation.

5. Tighten end cap assembly to cylinder securely using trim cylinder spanner wrench (1/4 in. x 5/16 in. long pegs).



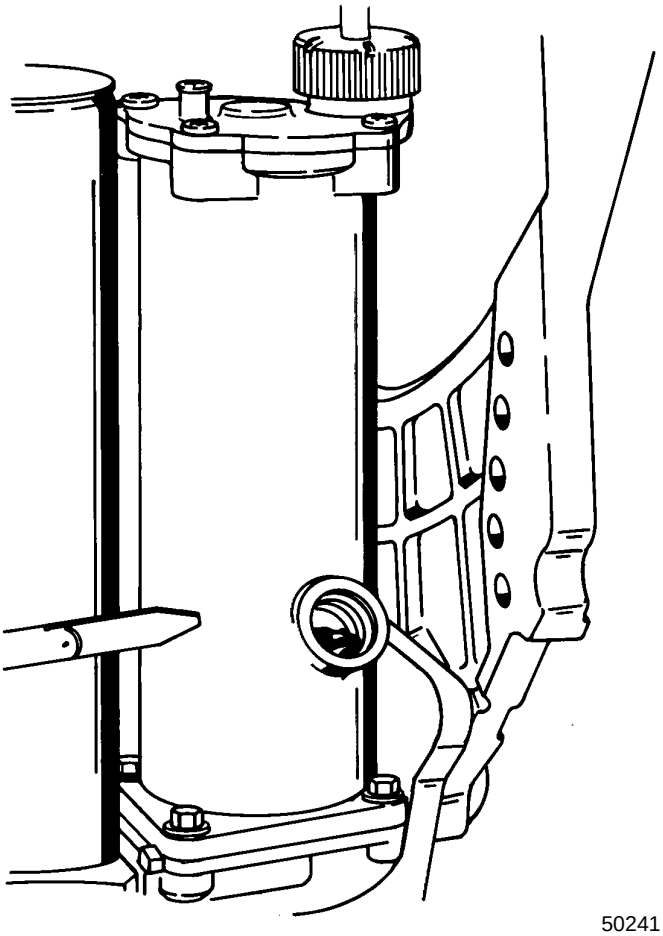
51145

6. Tighten manual release valve snuggly following end cap installation.

Bleeding Power Trim Unit

IMPORTANT: Manual release valve must be in the closed position during power trim bleeding and operation.

1. Secure power trim unit in soft jawed vise.
2. Remove fill screw. Add Quicksilver Power Trim and Steering Fluid (92-90100A12) or Automatic Transmission Fluid (ATF) Type F, FA or Dexron II up to threads of reservoir. Install cap.

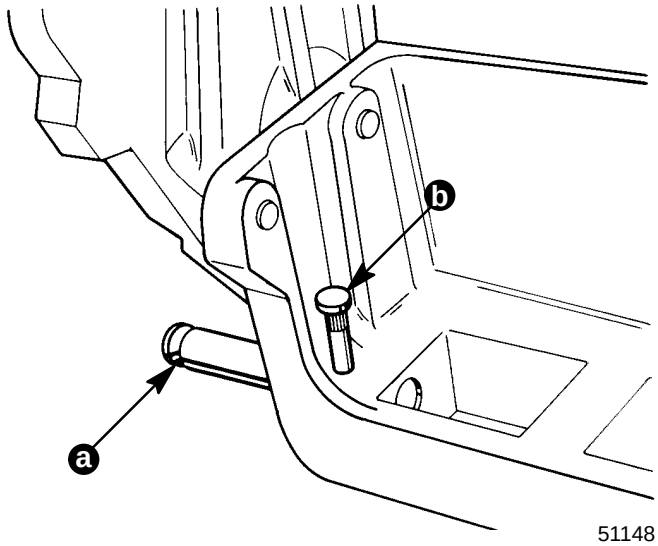


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3. Using a 12 volt power supply connect positive lead to green wire, negative lead to blue wire and drive trim rod to the down position. Connect positive lead to blue wire and negative lead to green wire and drive trim rod to the up position. Recheck fluid level, add fluid if required and repeat cycle until fluid level remains at lower portion of threads.

Power Trim Unit Installation

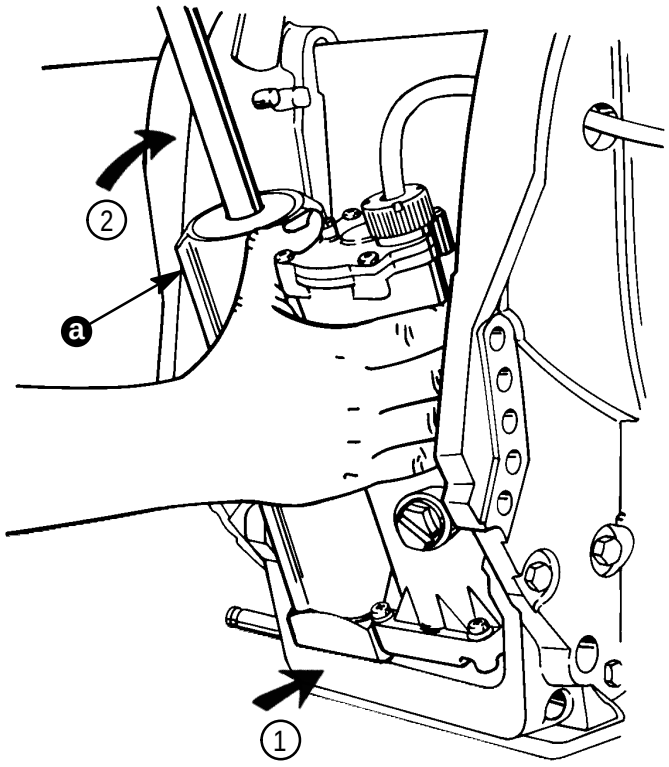
1. Apply Special Lubricant 101 (92-13872A1) to lower pivot pin hole and pivot pin surface.
2. Start lower pivot pin into pivot pin bore and position lower dowel pin (RETAINED) in its respective hole.



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a - Lower Pivot Pin
b - Lower Dowel Pin

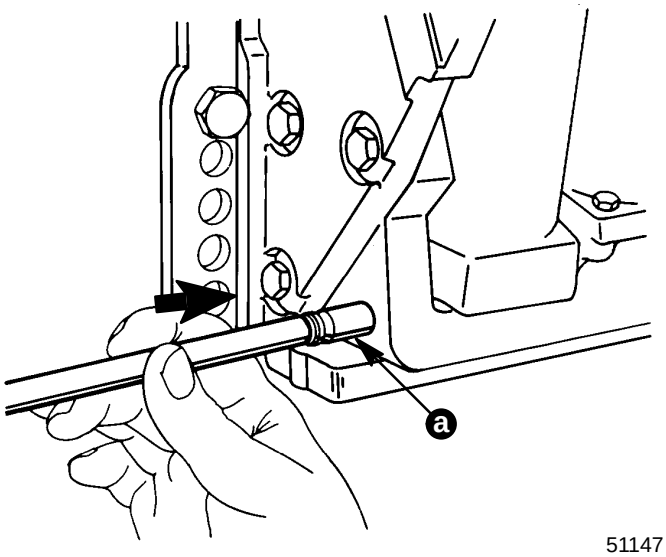
3. Position trim cylinder assembly (BOTTOM FIRST) between clamp brackets and route trim pump electrical harness through access hole in starboard clamp bracket.



51195

a - Trim Cylinder Assembly

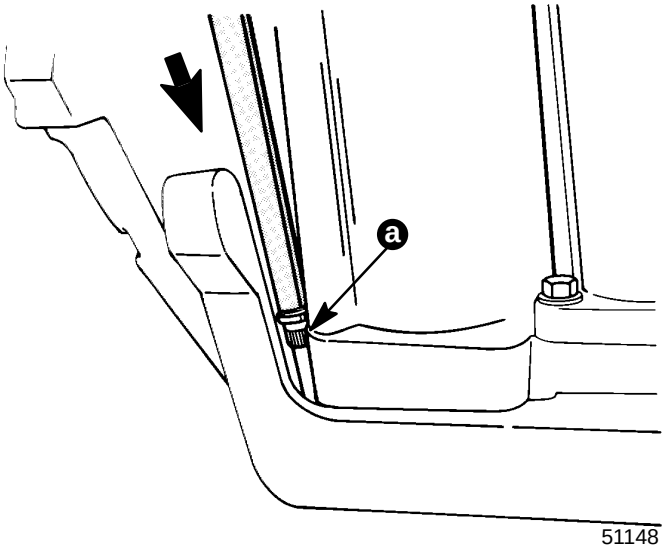
4. Using a suitable punch, drive lower pivot pin into clamp bracket and trim cylinder assembly until pivot pin is flush with outside surface.



51147

a - Lower Pivot Pin

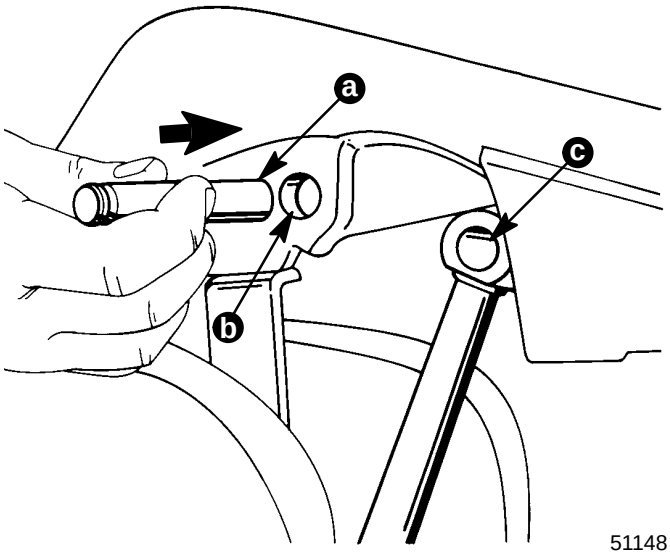
5. Using a suitable punch, drive lower dowel pin into its hole until seated.



51148

a - Lower Dowel Pin

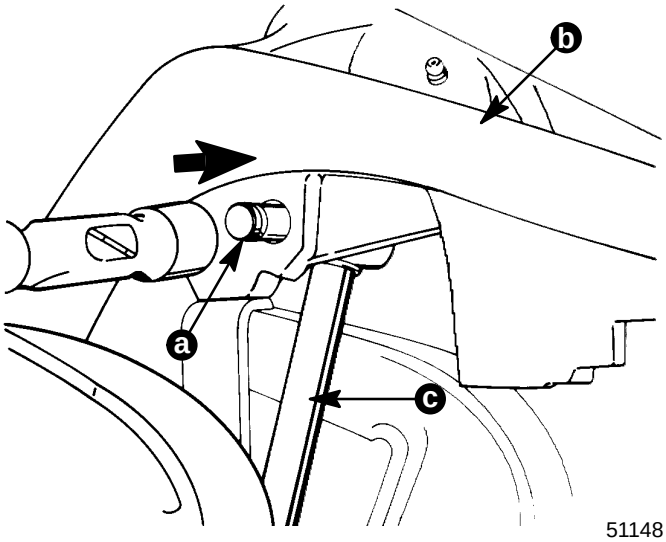
6. Apply Special Lubricant 101 (92-13872A1) to surface of upper pivot pin, pivot pin bore and trim ram bore.



51148

a - Pivot Pin
b - Pivot Pin Bore
c - Trim Ram Bore

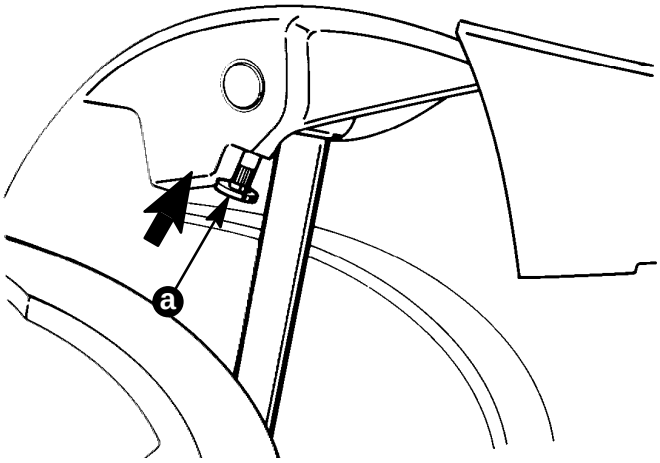
7. Using a suitable mallet, drive upper pivot pin into swivel bracket and through trim ram until pivot pin is flushed with swivel bracket.



51148

a - Pivot Pin
b - Swivel Bracket
c - Trim Ram

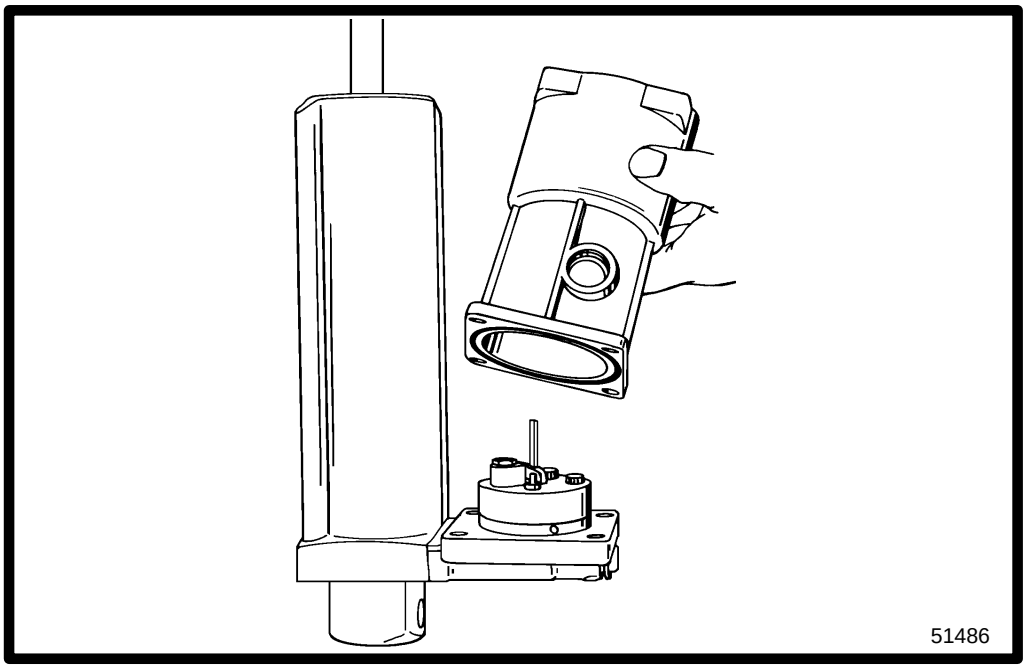
8. Drive upper dowel pin (a) into its hole until seated.



51147

9. Recheck fluid level.
10. Power trim may now be operated to lower outboard to desired position. Trim system is self bleeding.
11. Re-connect spark plug leads to spark plugs.
12. Re-install top cowl.
13. Connect battery leads to battery terminals.

MID-SECTION



POWER TRIM (DESIGN 3)

5

D

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Special Tools

Description	Part No.
Torch Lamp	91-63209
Spanner Wrench	91-74951
Multi-Meter DVA Tester	91-99750

Quicksilver Lubricants and Service Aids

Description	Part No.
Power Trim and Steering Fluid	91-9010012
Loctite 271	91-32609-1
Liquid Neoprene	91-25711-1
Anti-Corrosion Grease	91-78376A6

Power Trim - General Information

Description

The Power Trim system consists of an electric motor, pressurized fluid reservoir, pump and trim cylinder.

The remote control (or trim panel) is equipped with a switch that is used for trimming the outboard “up” and “down”, and for tilting the outboard for shallow water operation (at slow speed) or for “trailering”. The outboard can be trimmed “up” or “down” while engine is under power or when engine is not running.

Trimming Characteristics

When trimming outboard from a mid-trim position (trim tab in neutral, straight fore-and-aft position), you can expect the following results:

TRIMMING OUTBOARD “UP” (“OUT”)

⚠ WARNING

Excessive trim “out” may reduce the stability of some high speed hulls. To correct instability at high speed, reduce the power gradually and trim the motor “In” slightly before resuming high speed operation. (Rapid reduction in power will cause a sudden change of steering torque and may cause additional momentary boat instability.)

Will lift bow of boat, usually increasing top speed.

Transfers steering torque harder to port (left) on installations below 23 in. transom height.

Increases clearance over submerged objects.

In excess, can cause “porpoising” and/or ventilation.

In excess, can cause insufficient water supply to water pump resulting in serious water pump and/or powerhead overheating damage.

⚠ WARNING

Excessive engine trim angle will result in insufficient water supply to water pump causing water pump and/or powerhead overheating damage. Make sure that water level is above gear housing water intake holes whenever engine is running.

Operating “Up” circuit will actuate the “up” relay (located under engine cowl) and close the electric motor circuit. The electric motor drives the pump, forcing fluid thru internal passageways into the “up” side of the trim cylinder.

The trim cylinder/trim ram will position the engine at the desired trim angle within the 20° maximum trim range. The Power Trim system is designed so the engine cannot be trimmed beyond the 20° maximum trim angle as long as engine RPM is above approximately 2000 RPM.

The engine can be raised beyond the 20° maximum trim angle for shallow water operation, etc., by keeping the engine RPM below 2000 RPM. If engine RPM increases above 2000 RPM, the thrust created by the propeller (if deep enough in the water) will cause the trim system to automatically lower the engine back to the 20° maximum trim angle.

TRIMMING OUTBOARD “DOWN” (“IN”)

⚠ WARNING

Excessive speed at minimum trim “In” may cause undesirable and/or unsafe steering conditions. Each boat should be tested for handling characteristics after any adjustment is made to the tilt angle (tilt bolt relocation).

Will help planing off, particularly with a heavy load.

Usually improves ride in choppy water.

In excess, can cause boat to veer to the left or right (bow steer).

Transfers steering torque harder to right (or less to the left).

Improves planing speed acceleration (by moving tilt bolt one hole closer to transom).

Operating “Down” circuit will actuate the “down” relay (located under engine cowl) and close the electric motor circuit (motor will run in opposite direction of the “Up” circuit). The electric motor will drive the pump, forcing fluid thru internal passageways into the “down” side of the tilt ram. The tilt ram will move the engine down to the desired angle.

Trailering Outboard

⚠ WARNING

Excessive engine trim angle will result in insufficient water supply to water pump causing water pump and/or powerhead overheating damage. Make sure that water level is above gear housing water intake holes whenever engine is running.

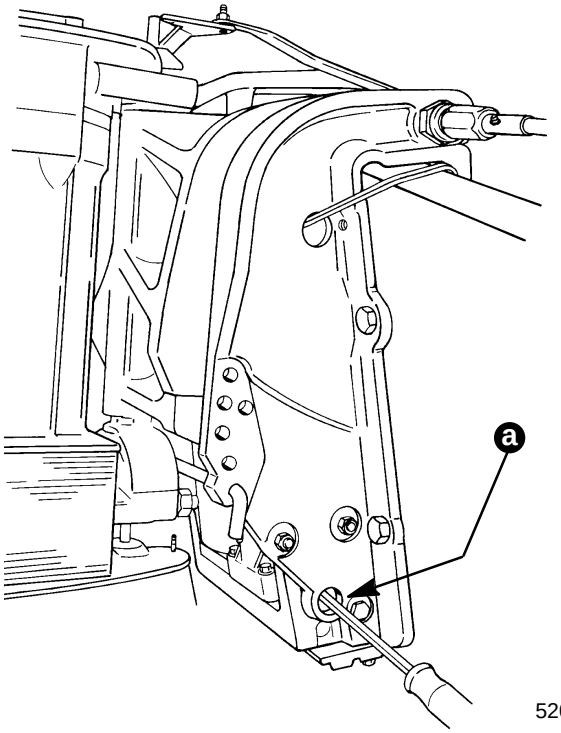
While operating “up” circuit, the ram will continue to tilt outboard to full up position for trailering.

Tilting Outboard Up and Down Manually

⚠ WARNING

Before opening the manual release valve, make sure all persons are clear of engine as engine will drop to full “down” position when valve is opened.

With power trim installed, the outboard can be raised or lowered manually by opening the manual release valve 3 turns **maximum** (counterclockwise).



52028

a - Manual Release Valve

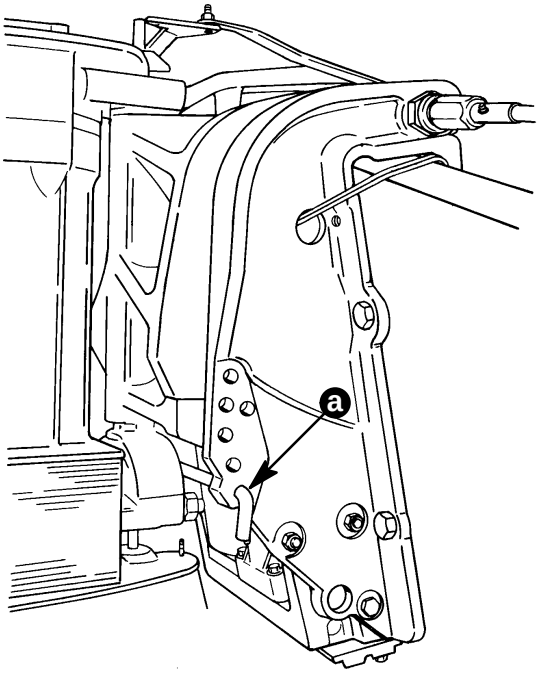
Trim “In” Angle Adjustment

⚠ WARNING

Operating some boats with engine trimmed to the full “in” trim angle [not using trim adjustment bolt (a)] at planing speed will cause undesirable and/or unsafe steering conditions. Each boat must be water tested for handling characteristics after engine installation and after any trim adjustments.

IMPORTANT: Some boat/motor combinations, that do not use the trim adjustment bolt (a) and are trimmed to the full “in” trim angle, will not experience any undesirable and/or unsafe steering conditions during planing speed. Thus, not using trim adjustment bolt may be desired. However, some boats with engine trimmed to the full “in” trim angle at planing speed will cause undesirable and/or unsafe steering conditions. If these steering conditions are experienced, under no circumstances should the engine be operated without the trim adjustment bolt and without the bolt adjusted in the proper holes to prevent unsafe handling characteristics.

Water test the boat not using the trim adjustment bolt. If undesirable and/or unsafe steering conditions are experienced (boat runs with nose down), install trim adjustment bolt in proper hole to prevent unsafe handling characteristics.

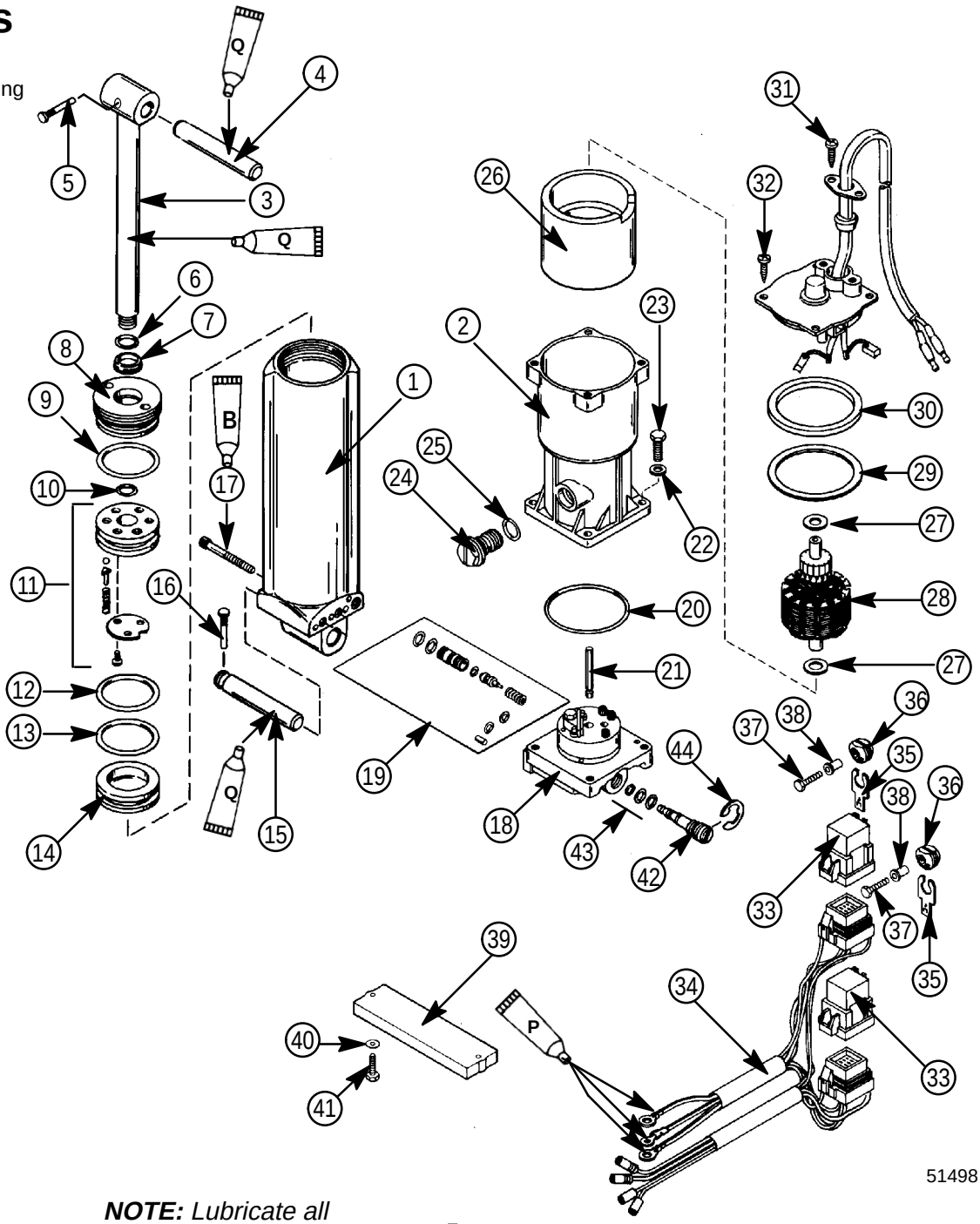


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a - Trim Adjustment Bolt

Power Trim System Components

1 - Tilt/Trim Cylinder
2 - Reservoir/Motor Housing
3 - Piston Rod
4 - Upper Pivot Shaft
5 - Cross Pin
6 - O-ring
7 - End Cap Seal
8 - End Cap
9 - O-ring
10- O-ring
11- Piston Assembly
12- O-ring
13- O-ring
14- Memory Piston
15- Lower Pivot Shaft
16- Cross Pin
17- Screw (2)
18- Pump Assembly
19- Pilot Valve Assembly
20- O-ring
21- Driveshaft
22- Washer (4)
23- Screw (4)
24- Fill Screw
25- O-ring
26- Motor Frame
27- Thrust Washer (2)
28- Armature
29- Ring
30- Seal
31- Screw (2)
32- Screw (4)
33- Relay
34- Wiring Harness
35- Relay Mount (2)
36- Rubber Mount (2)
37- Screw (2)
38- Spacer (2)
39- Anode
40- Washer (2)
41- Screw (2)
42- Manual Release Valve
43- O-ring
44- E-clip



NOTE: *Lubricate all O-rings and seals with* Q

Quicksilver Lubricants and Service Aids

- B — Loctite “271” (92-32609-1)
- P — Liquid Neoprene (92-25711-1)
- Q — Power Trim and Steering Fluid (92-90100A12)

Torque Specifications

- a - 100 lb. in (11.1 N·m)
- b - 13 lb. ft. (1.5 N·m)
- c - 70 lb. in. (7.7 N·m)
- d - 35 lb. in. (4.0 N·m)

Troubleshooting

Determining if Problem is Electrical or Hydraulic

When a problem is encountered with the Power Trim system, the first step is to determine whether the malfunction is in the “electrical system” or the “hydraulic system.” Refer to the following chart to determine which system is at fault.

Problem Chart

- Outboard will not trim up or down.
- Outboard trims up, will not trim down.
- Outboard trims down, will not trim up.
- Outboard will not return completely to “down” position or returns part way with jerky motion.
- Outboard thumps when shifted.
- Outboard trails out when backing off throttle at high speed.
- Outboard will not hold a trimmed position or will not remain tilted for any extended period.
- Outboard will not hold trim position when in reverse.

→ Determine if Power Trim pump motor operates when appropriate trim circuit is activated.

- Pump motor operates. → Refer to “Hydraulic System Troubleshooting.”
- Pump motor does not operate → Refer to “Electrical System Troubleshooting.”

Hydraulic System Troubleshooting

Support outboard with tilt lock lever when servicing power trim system.

After debris or failed components have been found (during troubleshooting procedures) disassemble unit completely and replace all O-rings. Check ball valve components and castings must be cleaned using engine cleaner and compressed air or replaced prior to reassembly.

Power trim system is pressurized. Outboard must be in the full "UP" position (cylinder fully extended) prior to fill screw or manual release valve removal.

Refer to instructions following if disassembly is required.

Follow preliminary checks before proceeding to troubleshooting flow diagrams (following).

Preliminary Checks

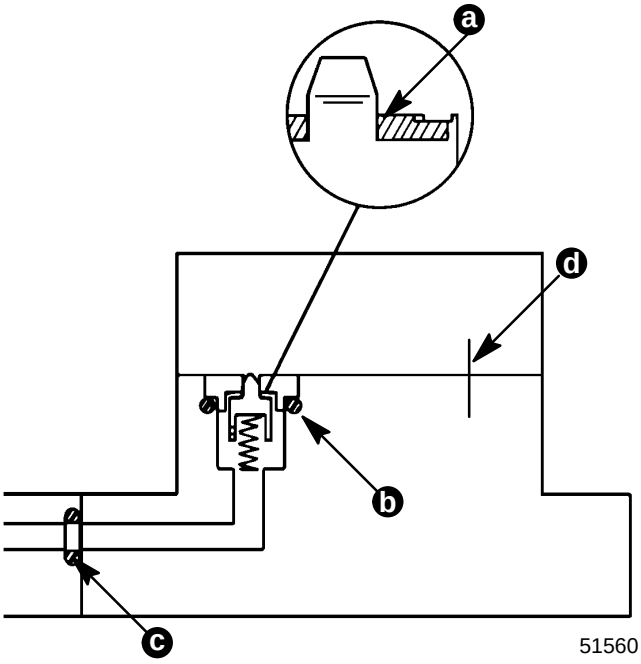
Operate Power Trim System after each check to see if problem is corrected. If not, proceed with the next check.

1. Check that manual release valve is tightened to full right (clockwise) position.
2. Check trim pump fluid level with outboard in full "UP" position and fill if necessary. Refer to "Fill and Purge the Power Trim System."
3. Check for external leaks in Power Trim system. Replace defective part(s) if leak is found.
4. Outboard not holding tilted position (falls to trim in position) indicates debris or defective components in trim valve assembly. Clean or replace components as required.
5. Check manual release valve for broken stem and one O-ring remaining in the release valve passage. (Separate the manifold assembly from the cylinder to dislodge broken stem.) Install new release valve and test system.
6. Check for nicked, deteriorated, or misplaced O-rings throughout trim system.

Leak Down Check - Pump and Manifold Assembly

NOTE: *Scribe (d) pump housing and manifold before disassembly.*

1. Debris or chips between valve and seat (a), usually imbedded in rubber valve seat.
2. Nicked or deteriorated O-ring (b).
3. Nicked, deteriorated, or misplaced O-ring (c).



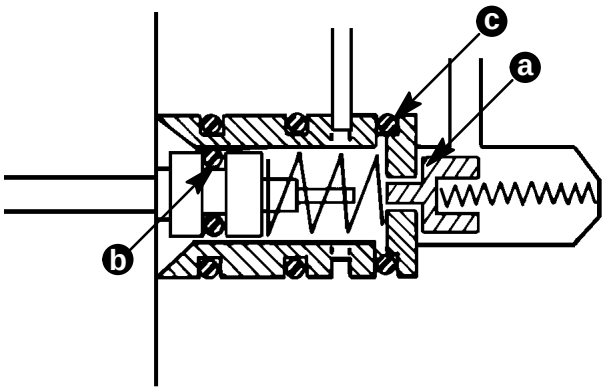
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4. After reassembly, insert driveshaft and check pump rotor resistance to turning - housing halves can shift/turn during reassembly. Align scribe marks (d) carefully.

Leak Down Check - Pilot Valve Assembly

1. Debris or chips between valve and seat (a), usually imbedded in rubber valve seat.
2. Pilot valve installed from non-chamfered end of spool, results in nicked or damaged O-ring (b).
3. Nicked or deteriorated O-ring (c).

A leak path is created between the UP side of the cylinder and the reservoir. The trim system will leak down until the trim port in cylinder is covered.

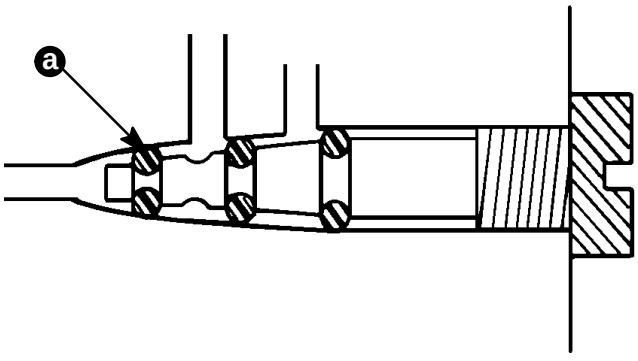


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a - Valve and Seat
b - Pilot Valve O-ring
c - O-ring

Leak Down Check - Manual Release Valve

1. Debris or chips under O-ring (a).
2. Flash from valve molding causing O-ring (a) to not seal.
3. Nicked O-ring (a).



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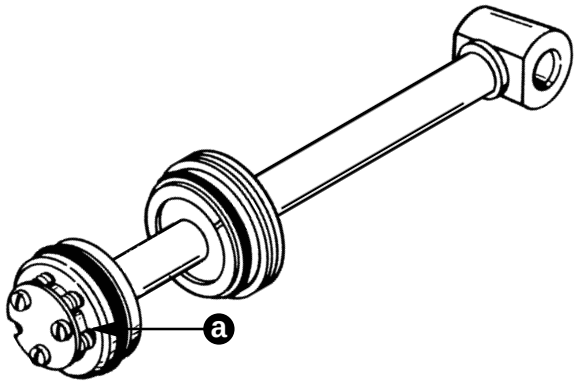
a - O-ring

Leaks Past Ball and Seat - Piston Assembly

Unit will trim to full or near full down position and then will begin to trim up while trim switch is held in "DOWN" mode.

If trim switch is released, outboard can be pushed (by hand) down to the point where trim UP started.

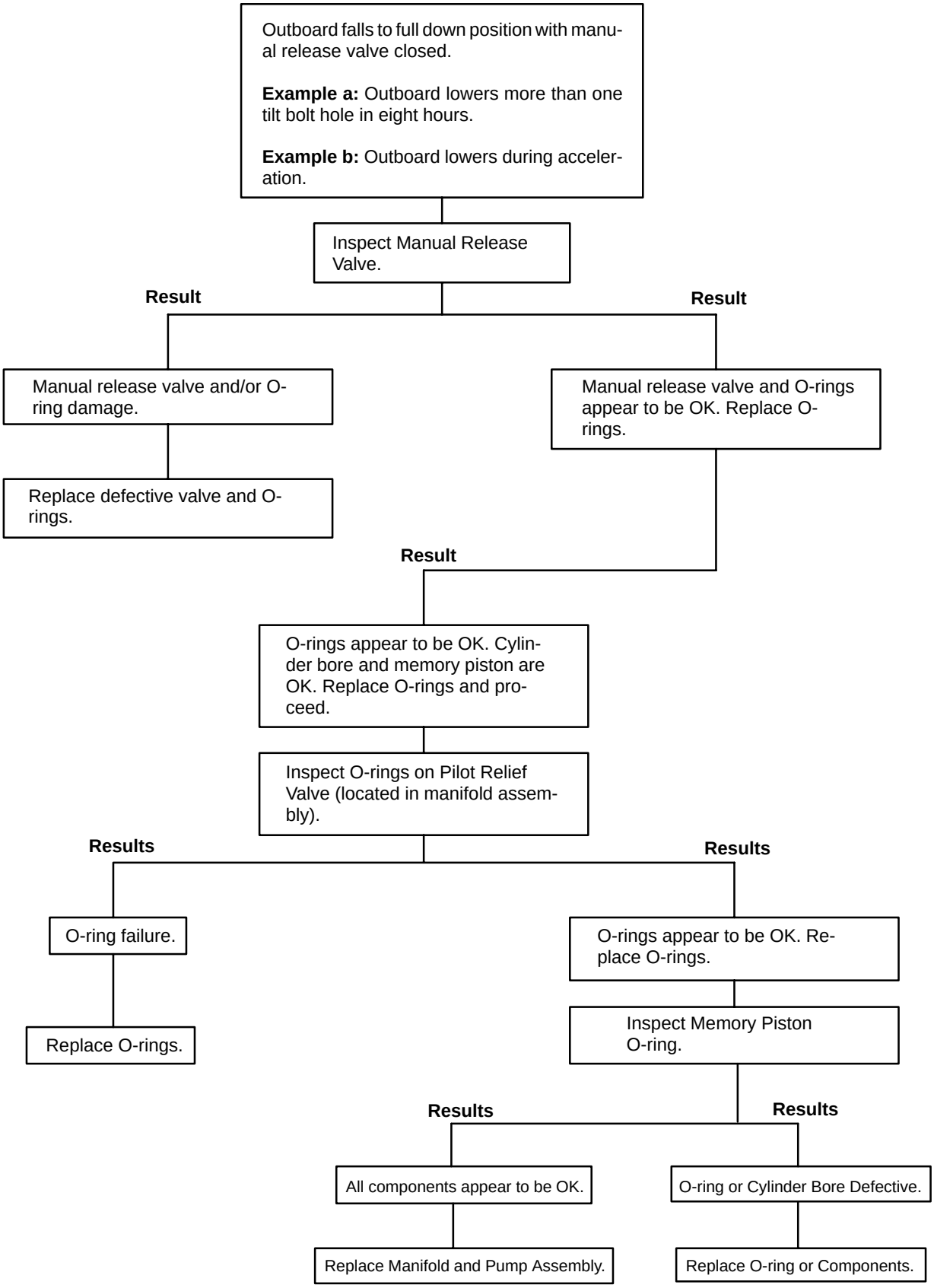
1. Inspect balls and seats in piston assembly for debris or damage. Repair or replace balls/seats.



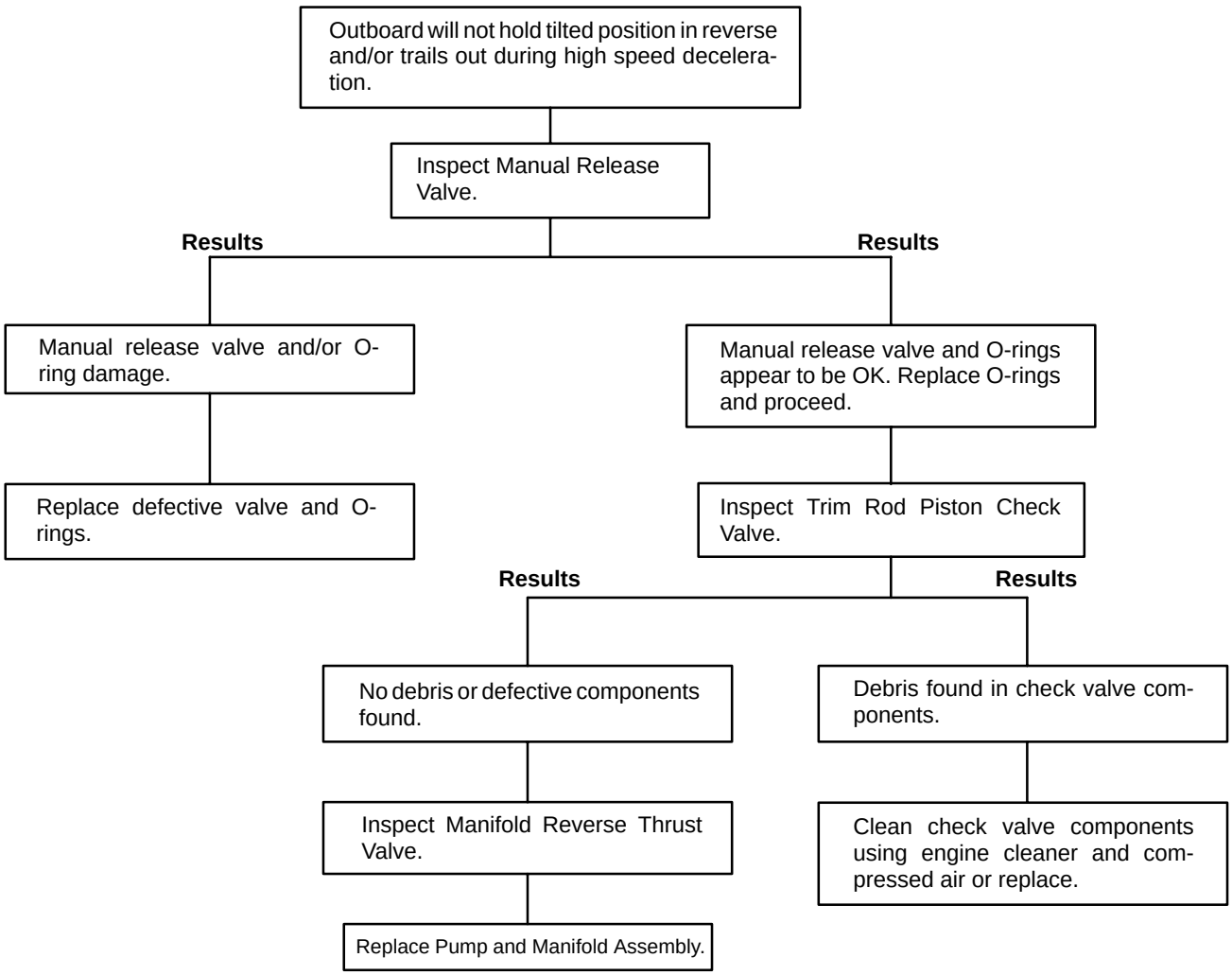
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a - Ball and Seat. Check All For Debris or Damage.

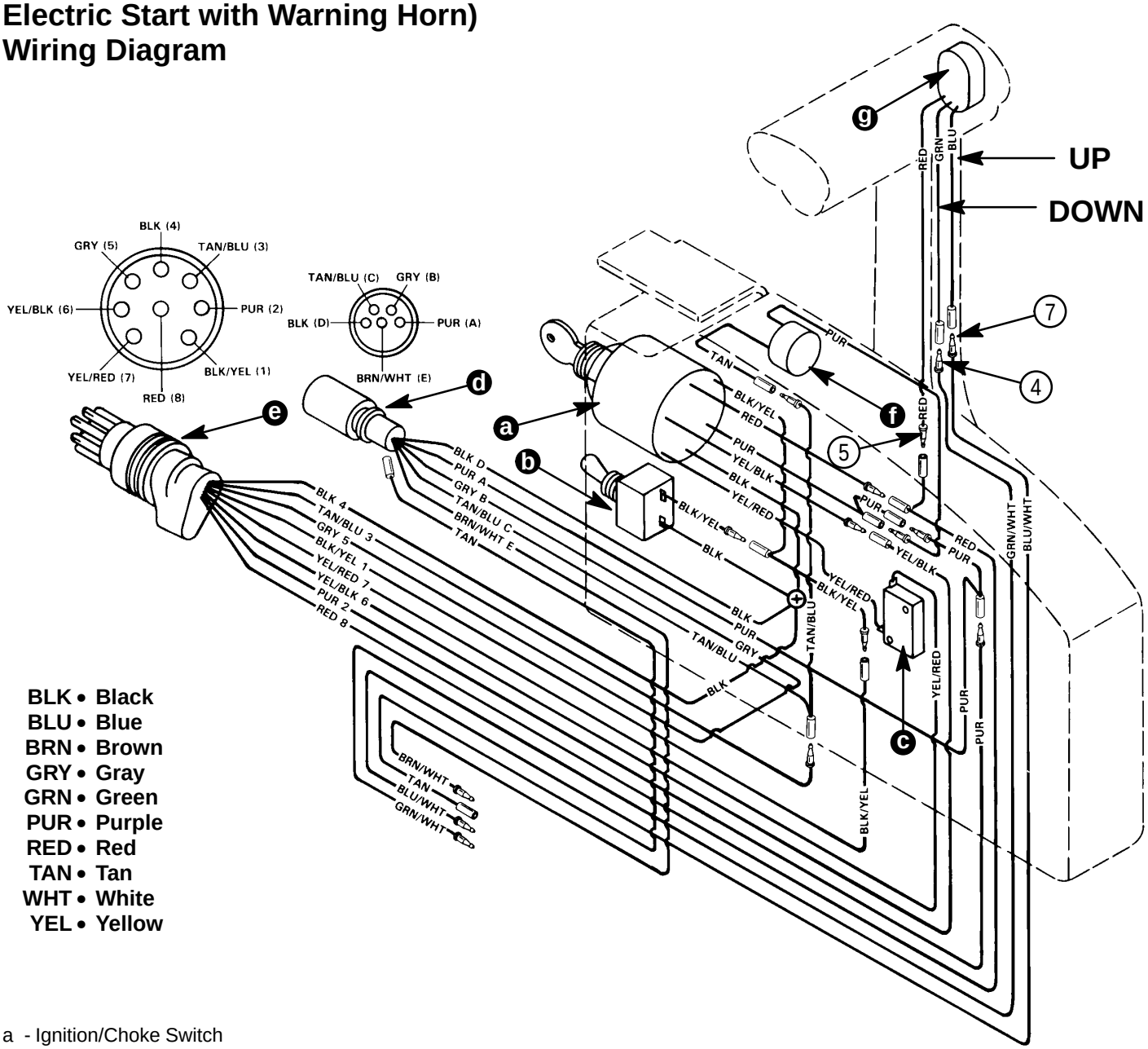
Troubleshooting Flow Diagram


Outboard falls to full down position with manual release valve closed.
Example a: Outboard lowers more than one tilt bolt hole in eight hours.
Example b: Outboard lowers during acceleration.
Inspect Manual Release Valve.
Result
Result
Manual release valve and/or O-ring damage.
Manual release valve and O-rings appear to be OK. Replace O-rings.
Replace defective valve and O-rings.
Result
O-rings appear to be OK. Cylinder bore and memory piston are OK. Replace O-rings and proceed.
Inspect O-rings on Pilot Relief Valve (located in manifold assembly).
Results
Results
O-ring failure.
O-rings appear to be OK. Replace O-rings.
Replace O-rings.
Inspect Memory Piston O-ring.
Results
Results
All components appear to be OK.
O-ring or Cylinder Bore Defective.
Replace Manifold and Pump Assembly.
Replace O-ring or Components.

Troubleshooting Flow Diagram


Outboard will not hold tilted position in reverse and/or trails out during high speed deceleration.
Inspect Manual Release Valve.
Results
Results
Manual release valve and/or O-ring damage.
Manual release valve and O-rings appear to be OK. Replace O-rings and proceed.
Replace defective valve and O-rings.
Inspect Trim Rod Piston Check Valve.
Results
Results
No debris or defective components found.
Debris found in check valve components.
Inspect Manifold Reverse Thrust Valve.
Clean check valve components using engine cleaner and compressed air or replace.
Replace Pump and Manifold Assembly.

COMMANDER 2000 Side Mount Remote Control (Power Trim/Tilt Electric Start with Warning Horn) Wiring Diagram

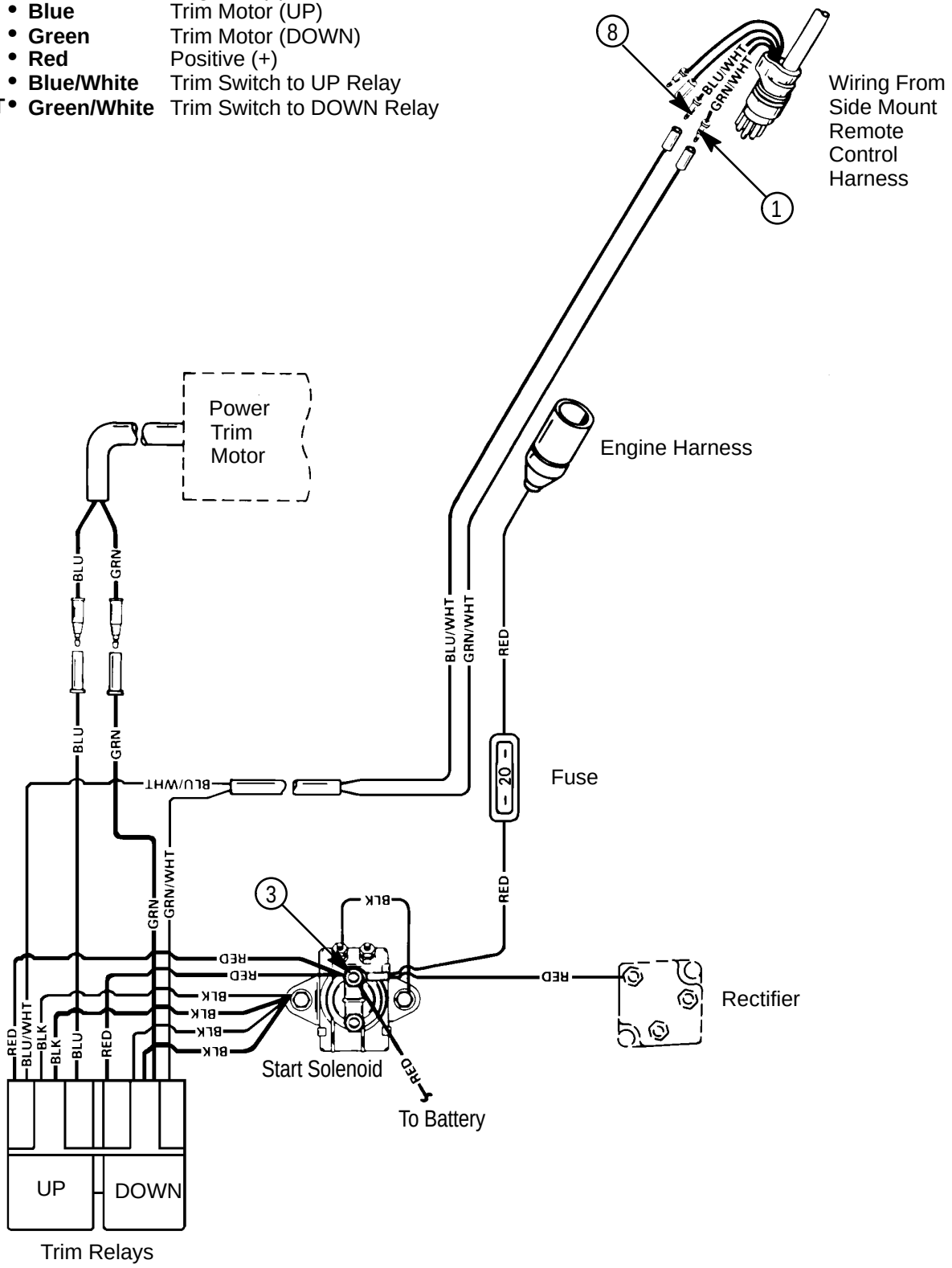


a - Ignition/Choke Switch
b - Emergency Stop Switch
c - Neutral Start Switch
d - Tachometer/Accessories Harness Connector
e - Wiring Harness Connector
f - Warning Horn
g - Trim/Tilt Switch

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Power Trim System Wiring Diagram

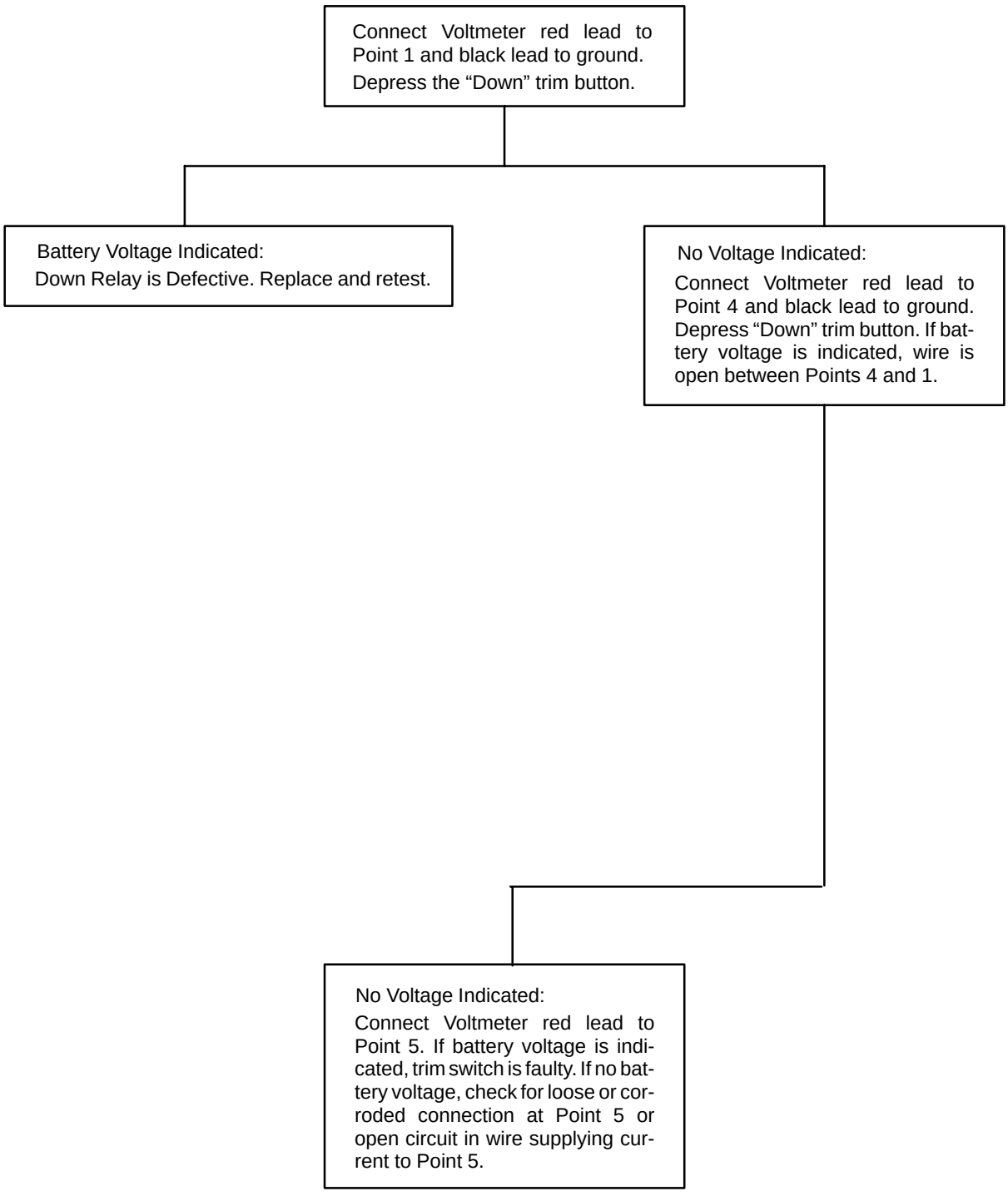
BLK •	**Black**	Negative (–)
BLU •	**Blue**	Trim Motor (UP)
GRN •	**Green**	Trim Motor (DOWN)
RED •	**Red**	Positive (+)
BLU/WHT •	**Blue/White**	Trim Switch to UP Relay
GRN/WHT •	**Green/White**	Trim Switch to DOWN Relay



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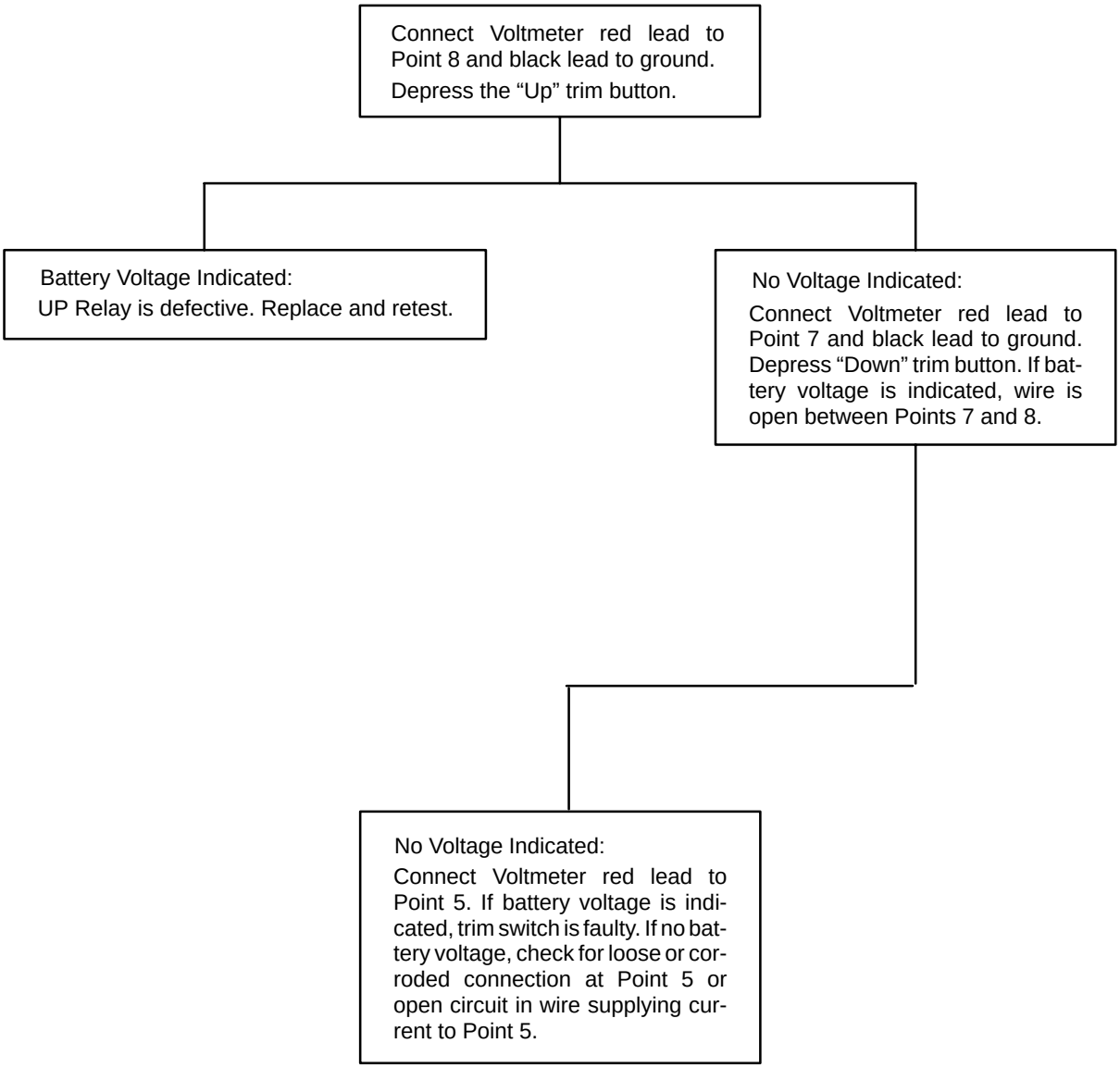
Troubleshooting the “Down” Circuit* (When “Up” Circuit is OK)

***Remote Control Not Equipped with Trailer Button**


Connect Voltmeter red lead to Point 1 and black lead to ground.
Depress the “Down” trim button.
Battery Voltage Indicated:
Down Relay is Defective. Replace and retest.
No Voltage Indicated:
Connect Voltmeter red lead to Point 4 and black lead to ground. Depress “Down” trim button. If battery voltage is indicated, wire is open between Points 4 and 1.
No Voltage Indicated:
Connect Voltmeter red lead to Point 5. If battery voltage is indicated, trim switch is faulty. If no battery voltage, check for loose or corroded connection at Point 5 or open circuit in wire supplying current to Point 5.

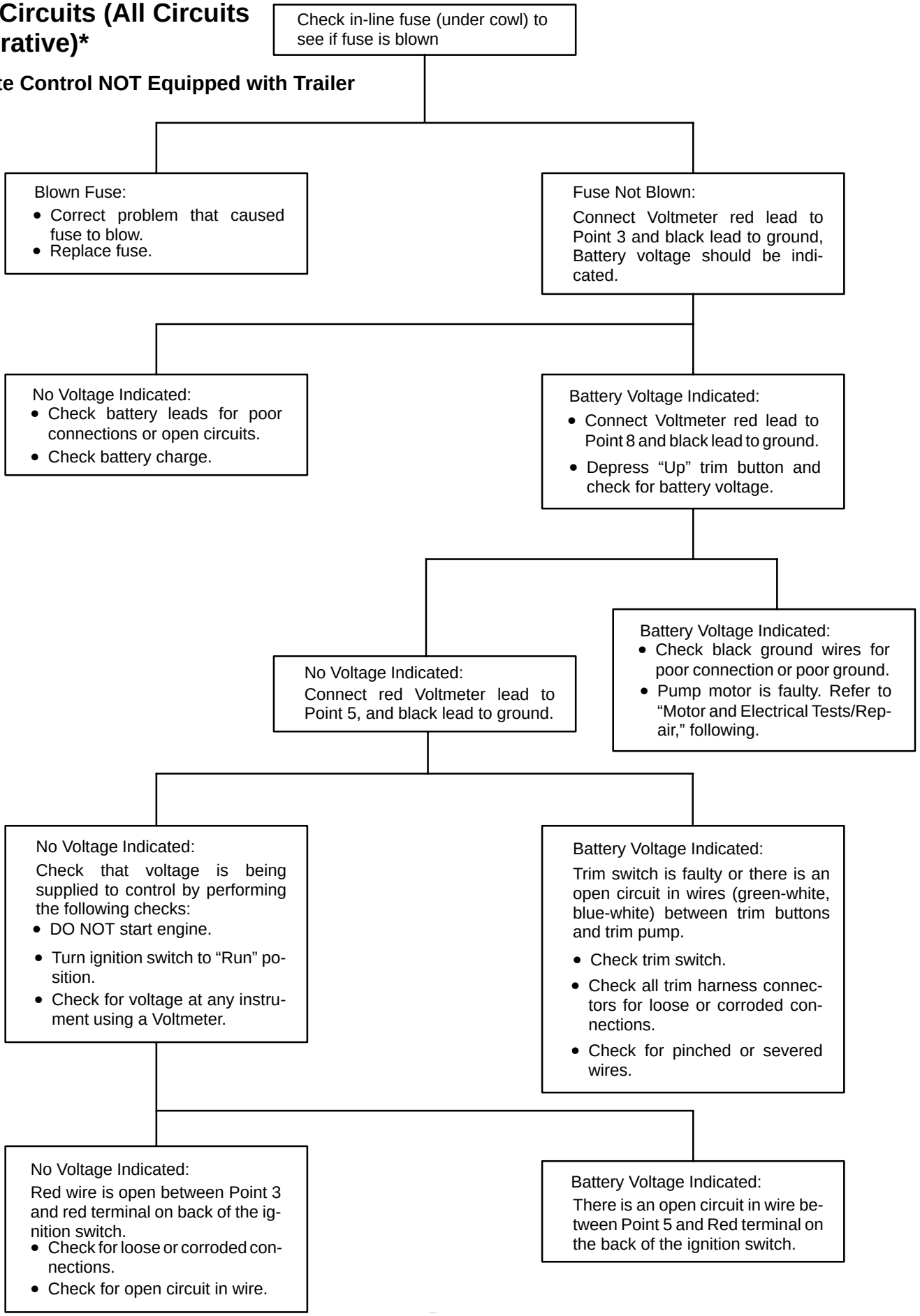
Troubleshooting the “Up” Circuit* (When “Down” Circuit Is OK)

***Remote Control NOT Equipped with Trailer Button**


Connect Voltmeter red lead to Point 8 and black lead to ground.
Depress the “Up” trim button.
Battery Voltage Indicated:
UP Relay is defective. Replace and retest.
No Voltage Indicated:
Connect Voltmeter red lead to Point 7 and black lead to ground. Depress “Down” trim button. If battery voltage is indicated, wire is open between Points 7 and 8.
No Voltage Indicated:
Connect Voltmeter red lead to Point 5. If battery voltage is indicated, trim switch is faulty. If no battery voltage, check for loose or corroded connection at Point 5 or open circuit in wire supplying current to Point 5.

Troubleshooting the “Down” and “Up” Circuits (All Circuits Inoperative)*

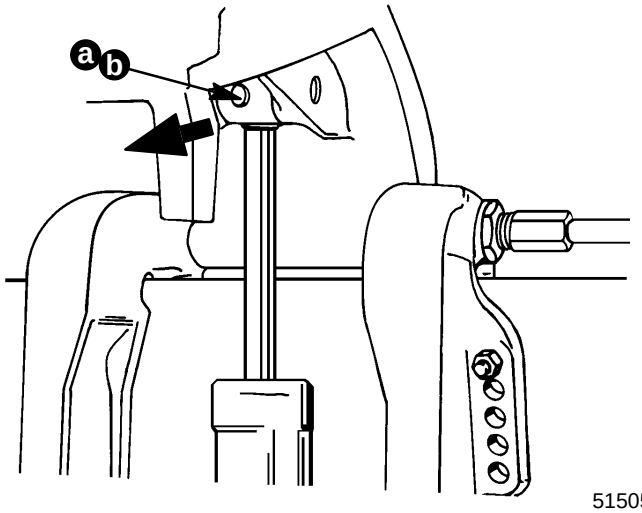
***Remote Control NOT Equipped with Trailer Button**


Check in-line fuse (under cowl) to see if fuse is blown
Blown Fuse:
• Correct problem that caused fuse to blow.
• Replace fuse.
Fuse Not Blown:
Connect Voltmeter red lead to Point 3 and black lead to ground, Battery voltage should be indicated.
No Voltage Indicated:
• Check battery leads for poor connections or open circuits.
• Check battery charge.
Battery Voltage Indicated:
• Connect Voltmeter red lead to Point 8 and black lead to ground.
• Depress “Up” trim button and check for battery voltage.
No Voltage Indicated:
Connect red Voltmeter lead to Point 5, and black lead to ground.
Battery Voltage Indicated:
• Check black ground wires for poor connection or poor ground.
• Pump motor is faulty. Refer to “Motor and Electrical Tests/Repair,” following.
No Voltage Indicated:
Check that voltage is being supplied to control by performing the following checks:
• DO NOT start engine.
• Turn ignition switch to “Run” position.
• Check for voltage at any instrument using a Voltmeter.
Battery Voltage Indicated:
Trim switch is faulty or there is an open circuit in wires (green-white, blue-white) between trim buttons and trim pump.
• Check trim switch.
• Check all trim harness connectors for loose or corroded connections.
• Check for pinched or severed wires.
No Voltage Indicated:
Red wire is open between Point 3 and red terminal on back of the ignition switch.
• Check for loose or corroded connections.
• Check for open circuit in wire.
Battery Voltage Indicated:
There is an open circuit in wire between Point 5 and Red terminal on the back of the ignition switch.

Power Trim System Removal

Support outboard with tilt lock lever when servicing power trim system.

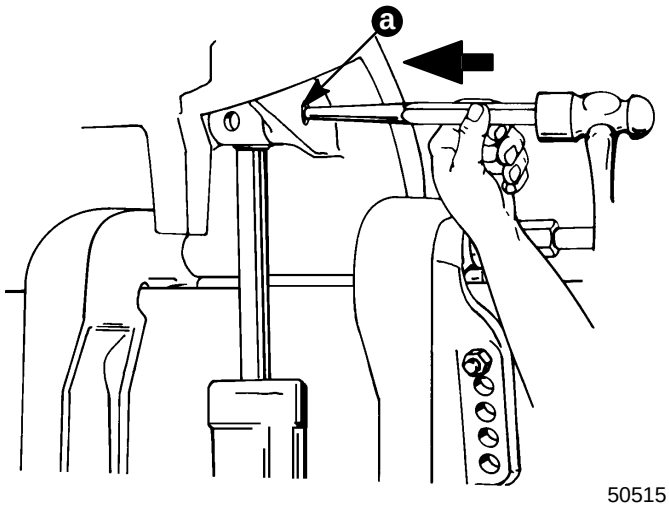
1. Disconnect power trim harness from outboard wiring harness.
2. Remove screw and clip securing wiring harness to clamp bracket.
3. Remove trim gauge sender (if equipped).
4. Use suitable tool to remove upper headed cross pin. Retain pin. Straight pin is hard to remove (see item 5).



51505

a - Cross Pin (Design 1 - Straight)
b - Cross Pin (Design 2 - Headed)

5. Drive out upper pivot pin. This will shear cross pin.

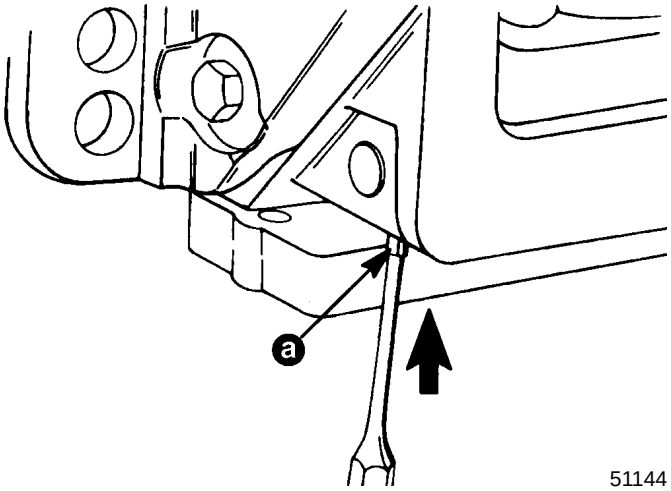


50515

a - Upper Pivot Pin

Inspect cross pin hole and pivot pin hole for damage.

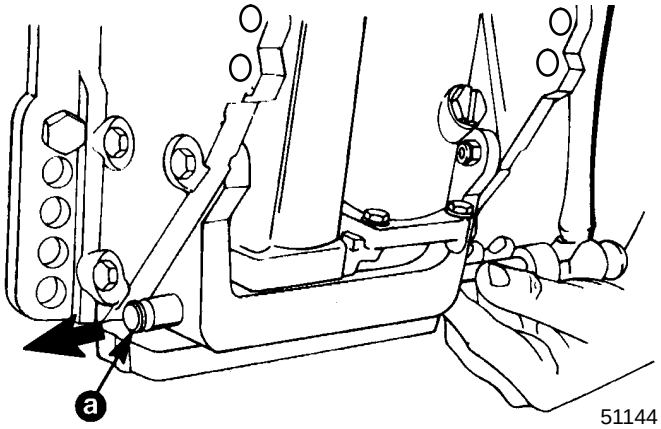
6. Use suitable punch to remove (DRIVE UP) lower dowel pin. Retain dowel pin.



51144

a - Cross Pin

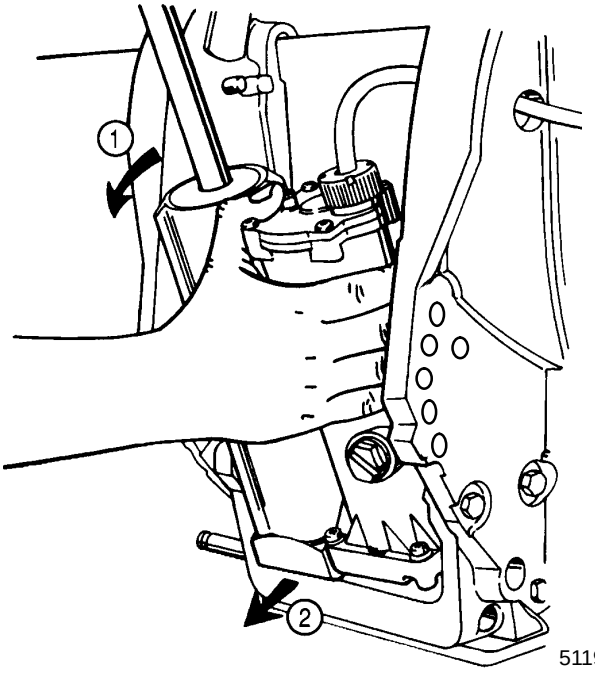
7. Use suitable punch to drive out lower pivot pin.



51144

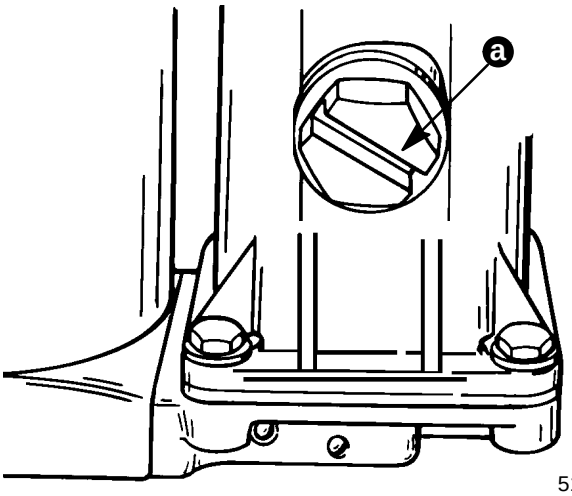
a - Pivot Pin

8. Tilt power trim assembly (top first) out from clamp bracket and remove assembly.



51195

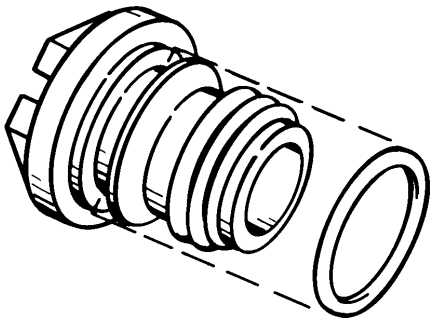
9. Remove fill screw and drain unit.



51505

a - Fill Screw

10. Remove O-ring from fill cap.

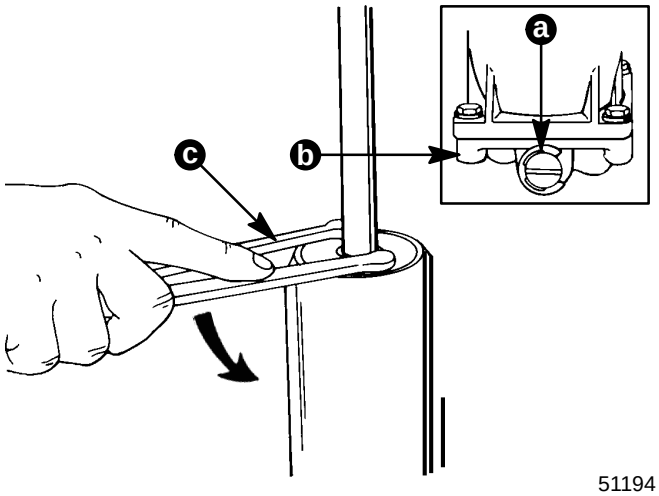


51194

Power Trim System Disassembly

Trim Rod Removal

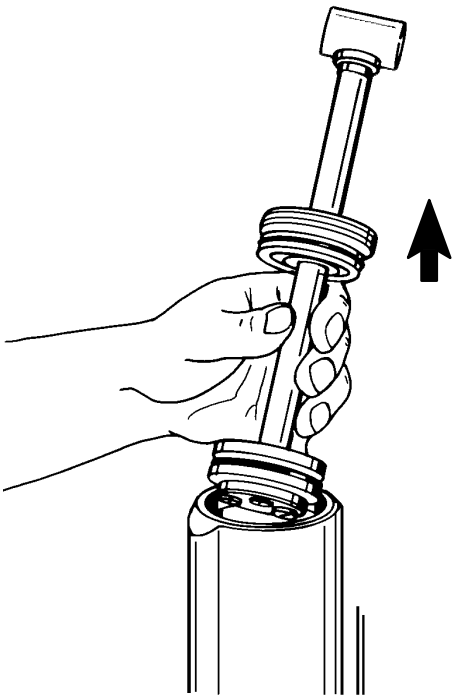
1. Secure power trim assembly in soft jawed vise.
2. Open manual release valve three turns **maximum** (counterclockwise) and position trim rod to full up position.
3. Remove cylinder end cap assembly from cylinder using spanner wrench (1/4 in. x 5/16 in. long pegs).



51194

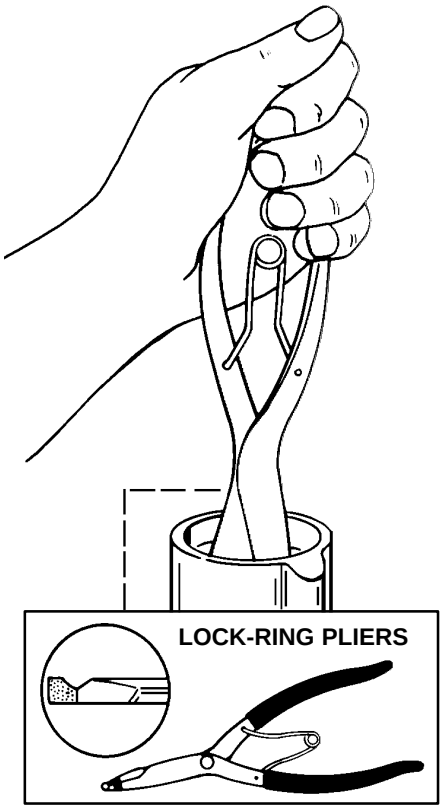
a - Manual Release Valve
b - Manifold
c - Spanner Wrench (P/N 91-74951)

4. Remove trim rod assembly from cylinder.



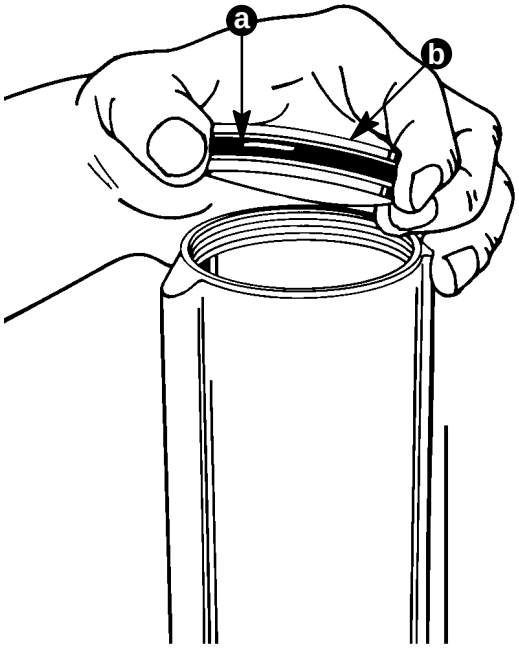
51196

5. Remove memory piston from cylinder using lock-ring pliers (Craftsman P/N 4735) or suitable tool.



51193

6. Remove O-ring from memory piston.



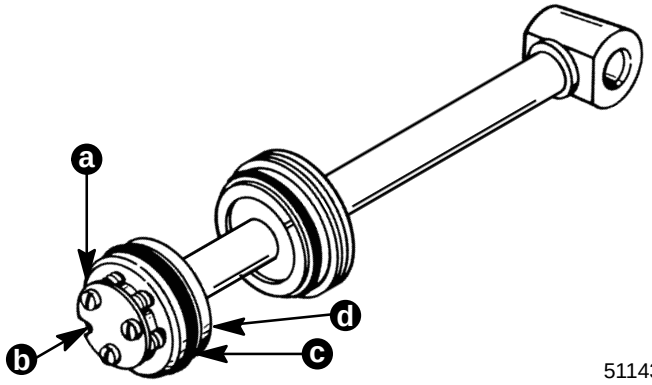
51196

a - O-ring
b - Memory Piston

7. Remove trim system from vise and empty fluid into appropriate container.

Trim Rod Disassembly

1. Place trim rod assembly on clean work surface.
2. Remove screws securing plate to trim rod piston and O-ring.
3. Remove check ball components from trim rod piston.



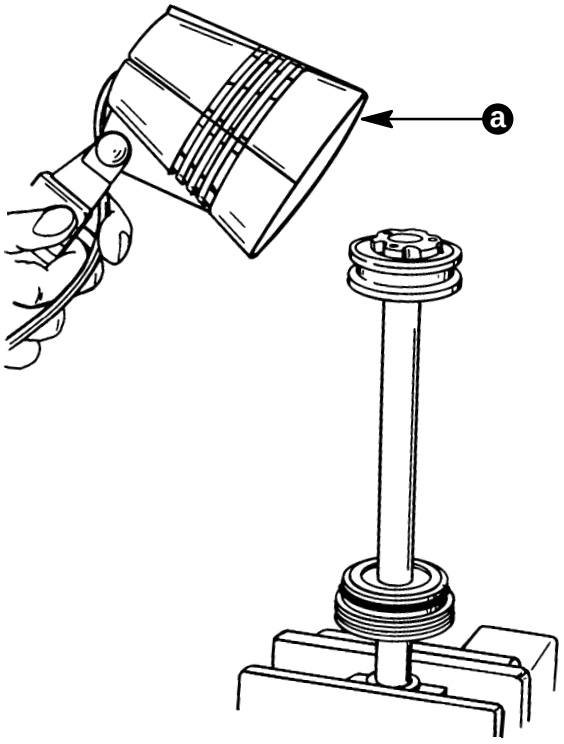
51143

a - Screw (3)
b - Plate
c - O-ring
d - Piston

⚠ CAUTION

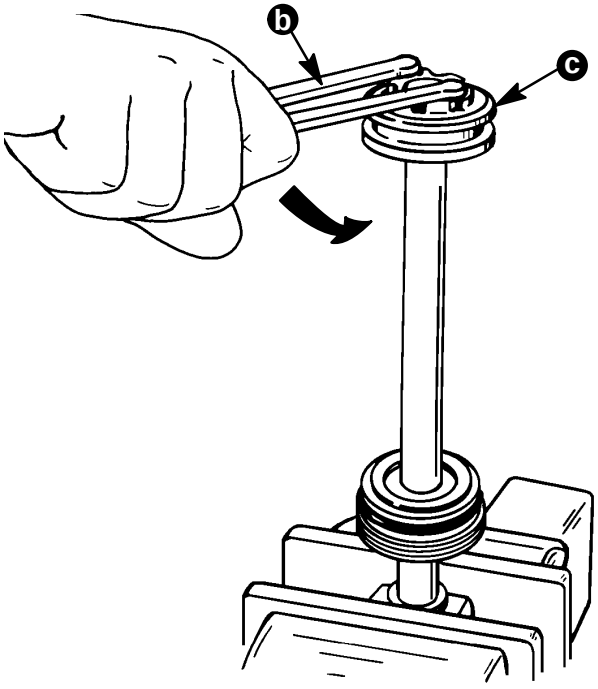
When removing Trim Rod piston, spanner wrench must have 1/4 in. x 5/16 in. long pegs to avoid damage to trim piston.

4. Place trim rod into soft jawed vise and apply heat to shock piston using torch lamp (a) (P/N 91-63209).
5. Loosen trim rod piston using spanner wrench (1/4 in. x 5/16 in. long pegs).
6. Allow trim rod piston to cool. Remove from trim rod.



51146

a - Torch Lamp



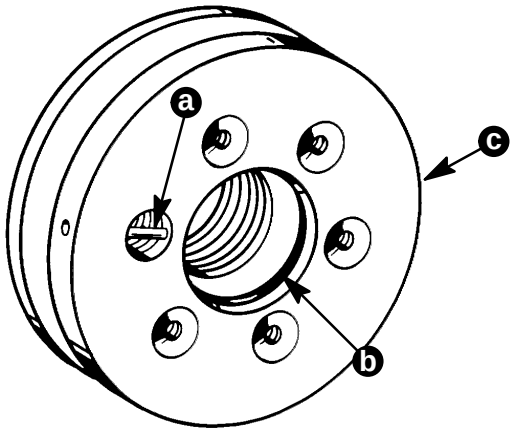
51146

b - Spanner Wrench
c - Trim Rod Piston

⚠ CAUTION

Do not remove check ball components (a) from trim rod piston. Removal and re-installation of check valve could result in improper operating pressure and possible power trim system damage. If check valve is defective, replace trim rod piston.

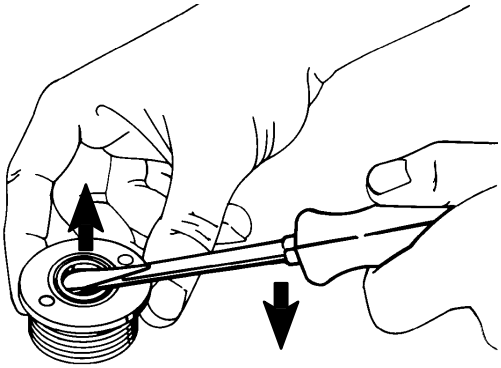
7. Remove inner O-ring from piston.



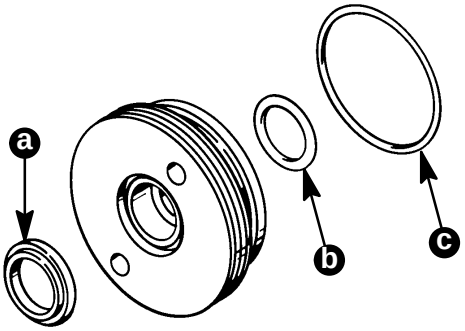
51199

a - Check Ball Components
b - O-ring
c - Piston

8. Remove rod wiper, inner O-ring and outer O-ring.



51147

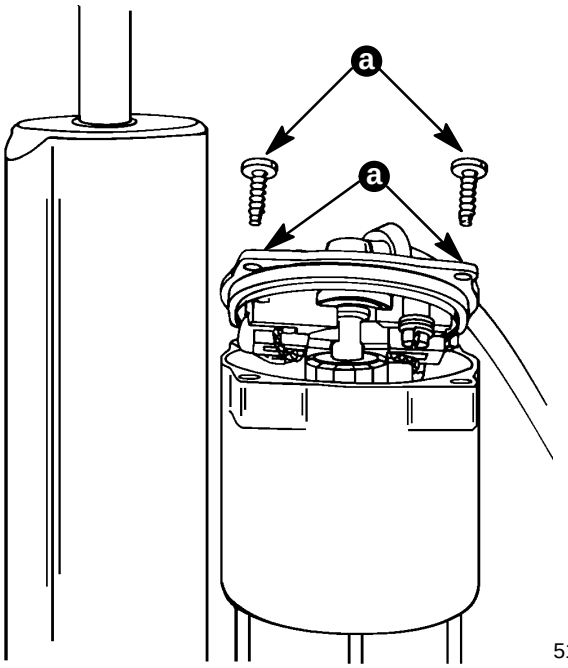


51145

a - Rod Wiper
b - Inner O-Ring
c - Outer O-Ring

Trim “Motor” Removal

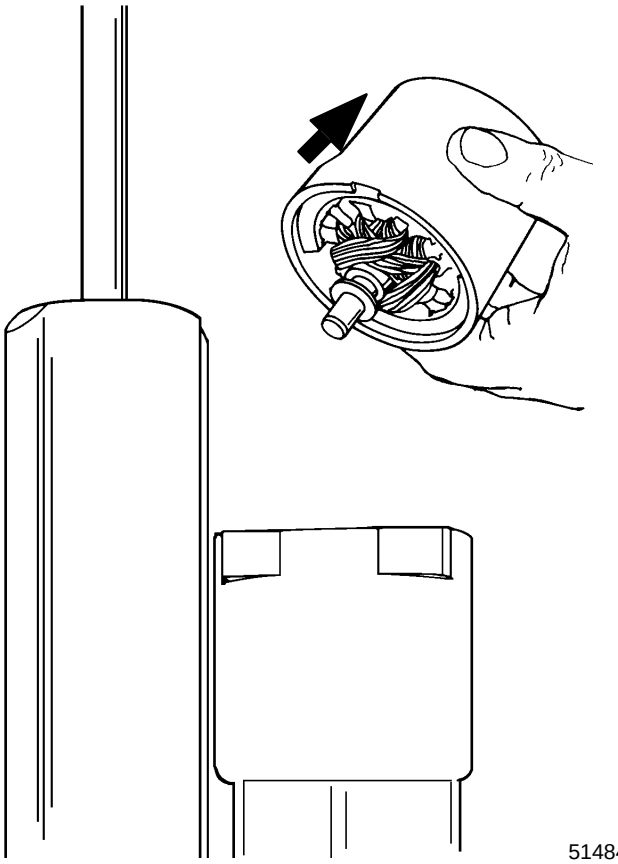
1. Secure power trim assembly in soft jawed vise.
2. Remove screws securing end cap to reservoir and remove end cap.



51486

a - Screws (4)

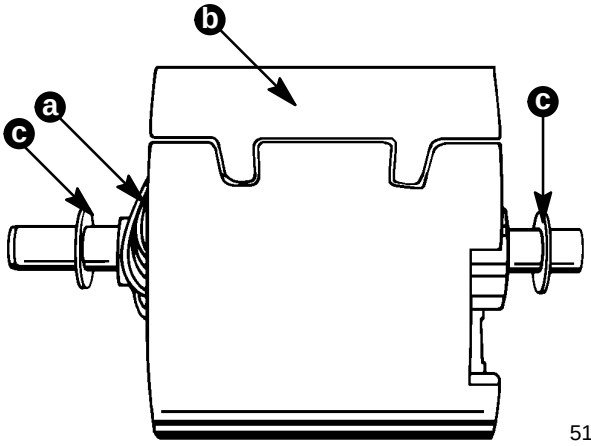
3. Remove motor from reservoir.



51484

Trim “Motor” Disassembly

1. Remove armature from motor frame. Note position of washers on armature.

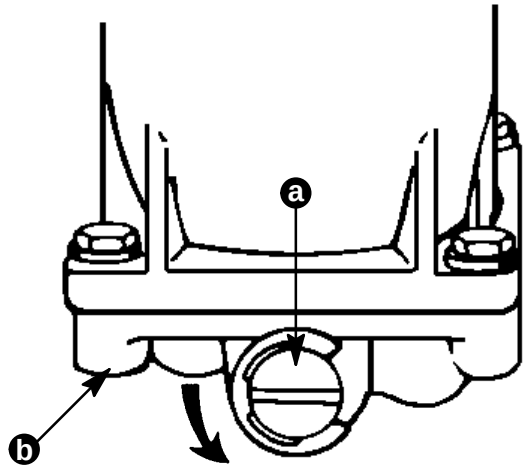


51486

a - Armature
b - Motor Frame
c - Washer (1 each end of armature)

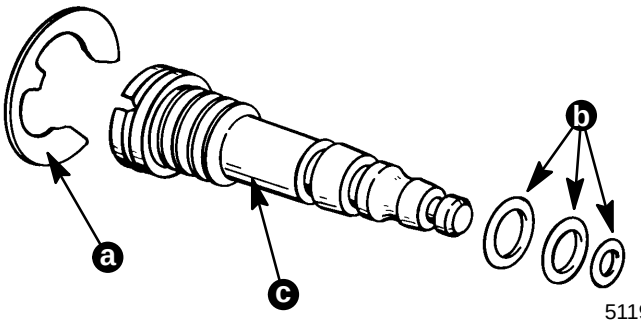
Reservoir Assembly Removal

1. Remove manual release valve from manifold.



a - Manual Release Valve
b - Manifold

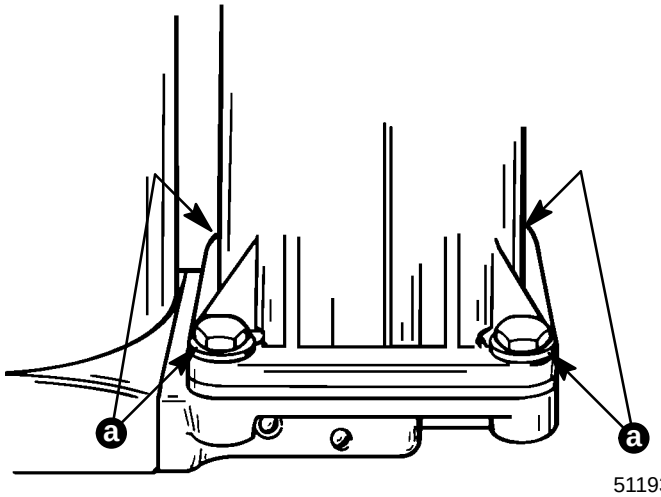
2. Remove “E” clip and O-rings from manual release valve.



51196

a - “E” Clip
b - O-rings
c - Manual Release Valve

3. Remove four screws securing reservoir to manifold.

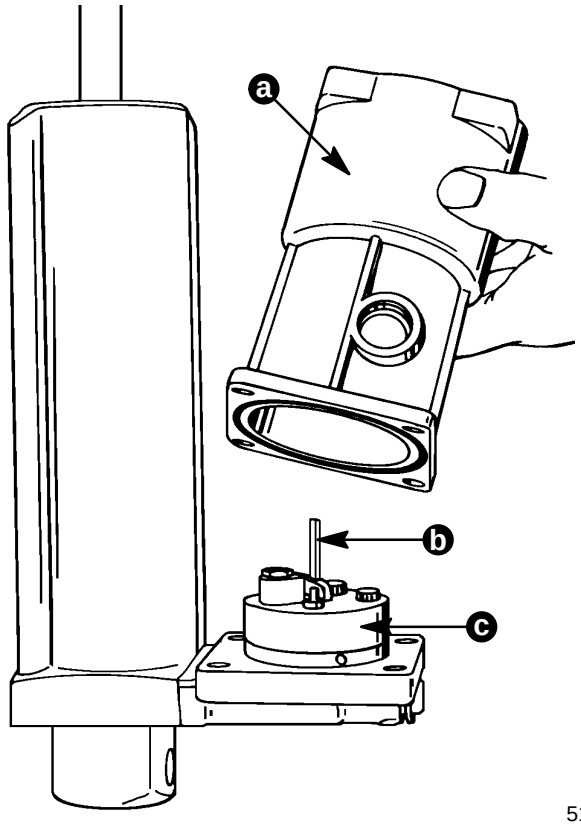


51193

a - Screws (4)

4. Remove reservoir from manifold.

5. Remove drive shaft from oil pump.

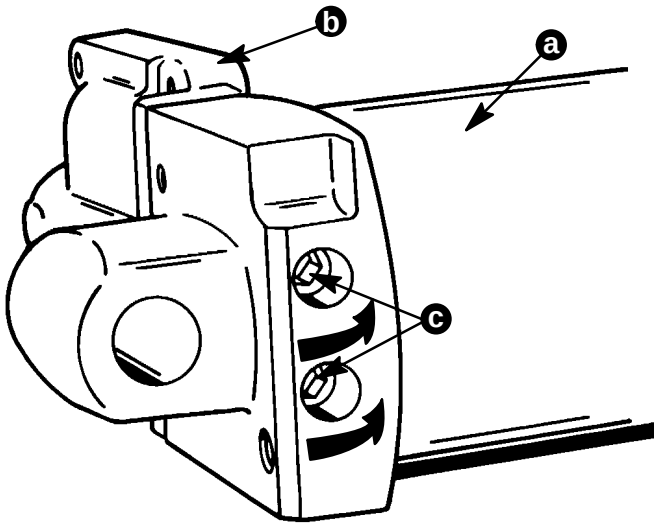


51486

a - Reservoir
b - Drive Shaft
c - Oil Pump

Manifold Removal

1. Remove screws and manifold from cylinder.

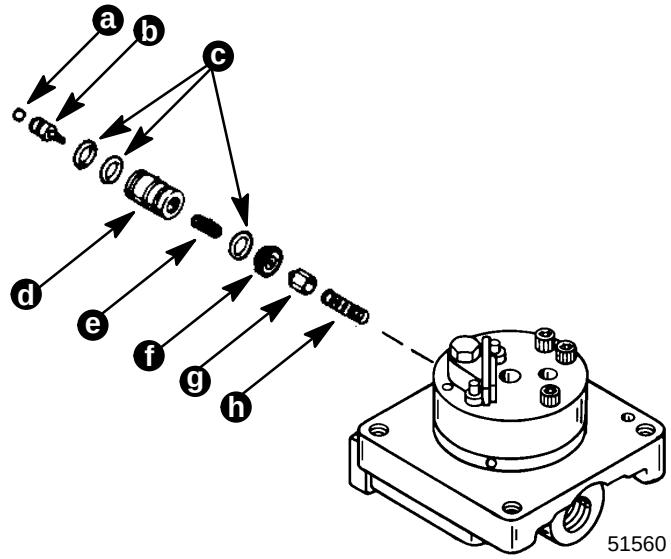


51007

a - Trim Cylinder
b - Manifold
c - Screw (2)

2. Remove check valve components from manifold.

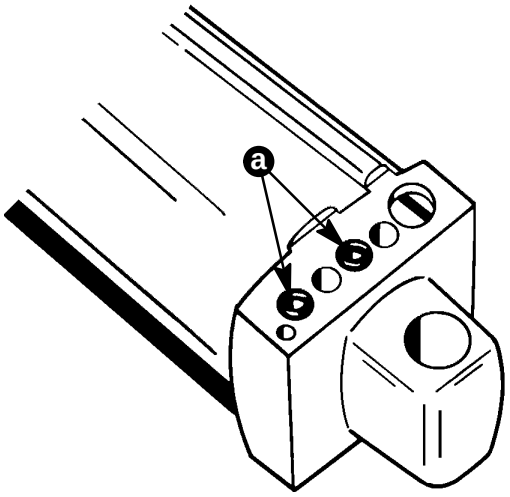
IMPORTANT: Sleeve (d) is chamfered on I.D. on end opposite drilled cross hole. Install spool (b) (with O-ring installed) from chamfered end of sleeve to avoid possibility of damaging O-ring on spool.



51560

a - O-ring (0.114 I.D.)
b - Spool
c - O-ring (0.301 I.D.) (3 each)
d - Sleeve
e - Spring
f - Valve Seat
g - Valve
h - Spring

3. Remove O-rings from cylinder.



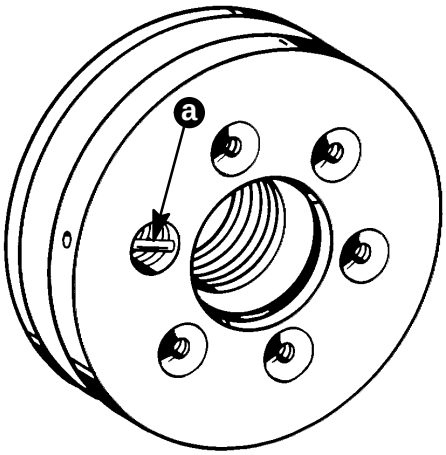
51008

a - O-rings (2)

Cleaning and Inspection of Trim Rod Components

⚠ CAUTION

Do not remove check ball components (a) from trim rod piston. Removal and re-installation of check valve could result in improper operating pressure and possible power trim system damage.



51199

Inspect check valve for debris; clean debris form check valve if found. If debris cannot be cleaned from check valve, replace trim rod piston as an assembly.

Clean trim rod and components with parts cleaner and dry with compressed air.

It is recommended that all O-rings in trim system be replaced.

Inspect trim rod. If scraper (located in cap) has failed to keep rod clean, replace scraper.

Lubricate all O-rings using Quicksilver Power Trim and Steering Fluid or; (ATF) Type F, FA or Dexron II.

Motor and Electrical Tests/Repair

Trim Pump Motor Test

⚠ WARNING

Do not perform this test near flammables (or explosives), as a spark may occur when making connections.

1. Disconnect green (motor) wire and blue (motor) wire from trim system wiring harness.
2. Connect a 12 volt power supply to motor wires (positive to blue; negative to green results in motor up direction. Positive to green; negative to blue results in motor down direction). Motor should run.
3. If motor does not run, disassemble motor and check components.

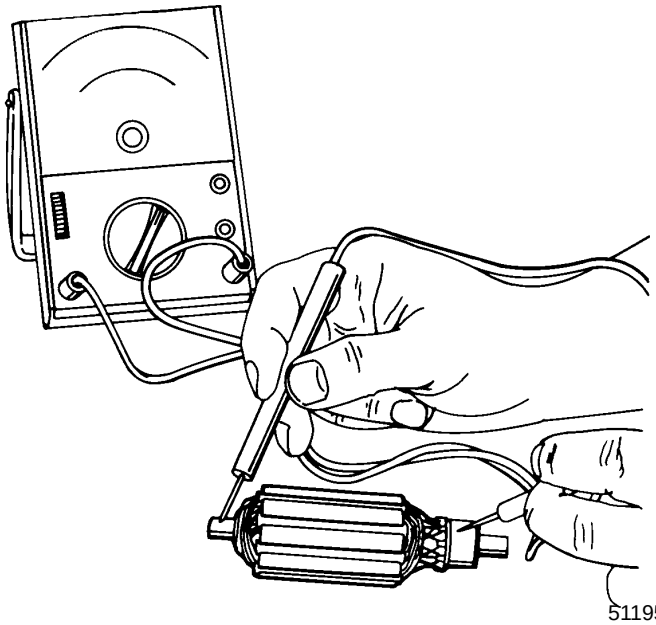
Armature Tests

TEST FOR SHORTS

Check armature on a Growler (follow Growler manufacturer's test instructions). Indication of a short requires replacement of armature.

TEST FOR GROUND

Use an Ohmmeter (R x 1 scale). Place one lead on Ohmmeter on armature shaft and other lead on commutator, as shown. If continuity is indicated, armature is grounded and must be replaced.

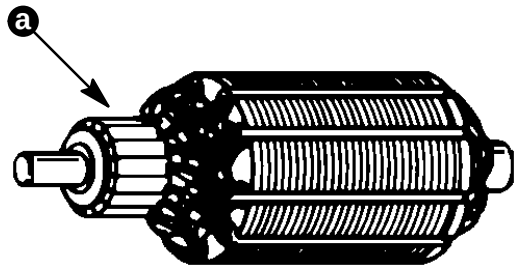


51195

CHECKING AND CLEANING COMMUTATOR

If commutator (a) is worn it can be turned down on an armature conditioner tool or on a lathe.

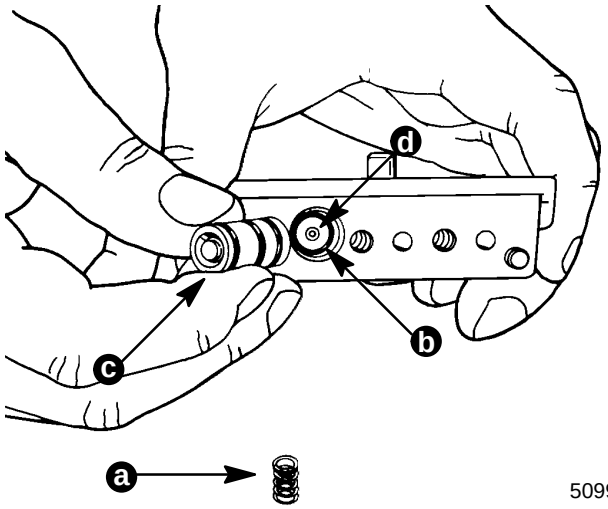
Clean commutator with “00” sandpaper.



Power Trim System Reassembly

Manifold Installation

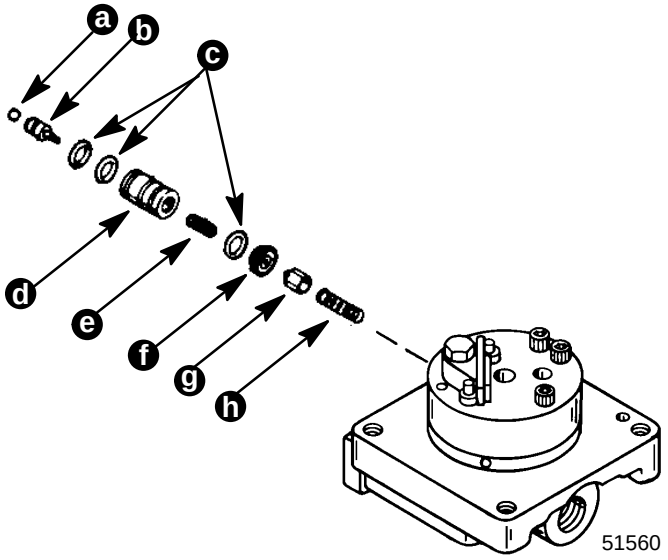
IMPORTANT: Install spring, check valve and O-ring into manifold. Position components in place using sleeve to seat in place. It is recommended that O-ring and valve seat be replaced when installing Screw and Seal Kit 811226A1 in manifold.



50999

a - Spring
b - O-ring
c - Sleeve
d - Valve Seat

1. Install check valve components into manifold.

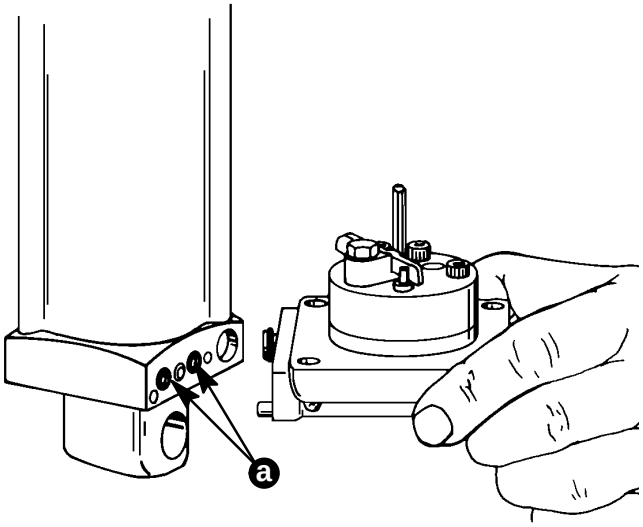


51560

a - O-ring (0.114 I.D.)
b - Spool
c - O-ring (0.301 I.D.) (3 each)
d - Sleeve
e - Spring
f - Valve Seat
g - Valve
h - Spring

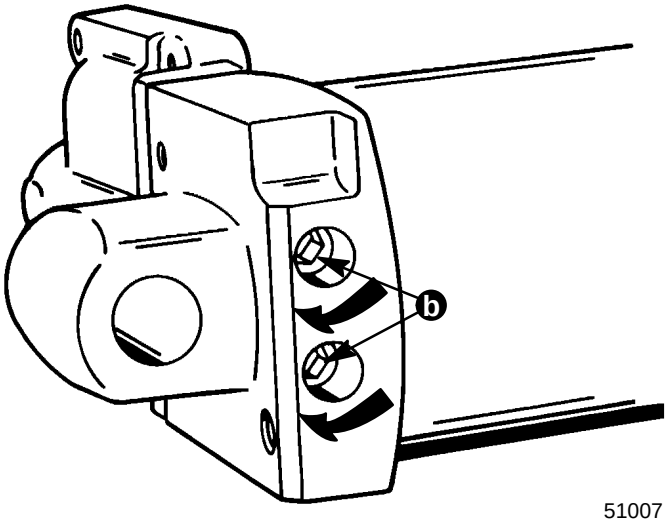
IMPORTANT: Sleeve (d) is chamfered on I.D. on end opposite drilled cross hole. Install spool (e) (with O-ring installed) from chamfered end of sleeve to avoid possibility of damaging O-ring on spool.

2. Install O-rings on cylinder and secure manifold assembly to cylinder using screws. Torque screws to 100 lb. in. (11.0 N·m).



51486

a - O-rings (2)



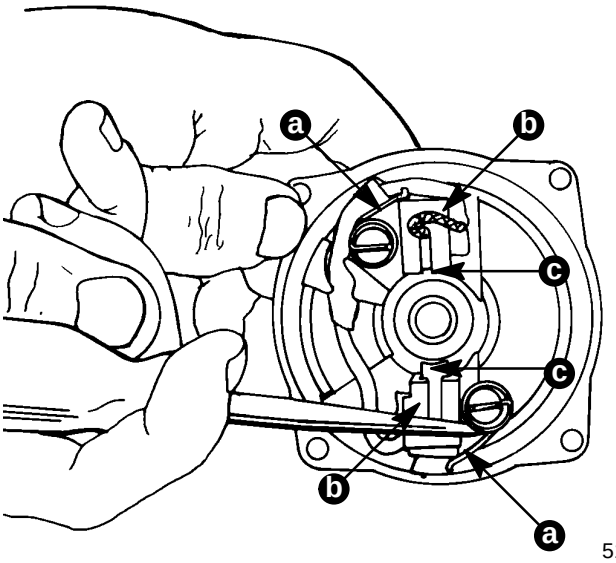
51007

b - Screws [100 lb. in. (11 N·m)] (2)

3. Secure power trim unit in soft jawed vise.

Trim Motor Reassembly

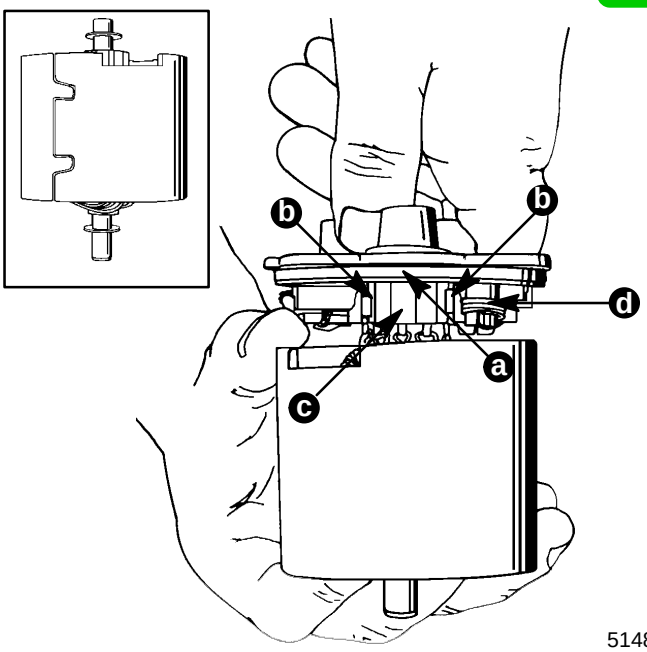
1. Place brush tension springs on outer ends of brush housings to release tension on brushes.



51485

a - Brush Tension Spring (2)
b - Brush Housing (2)
c - Brush (2)

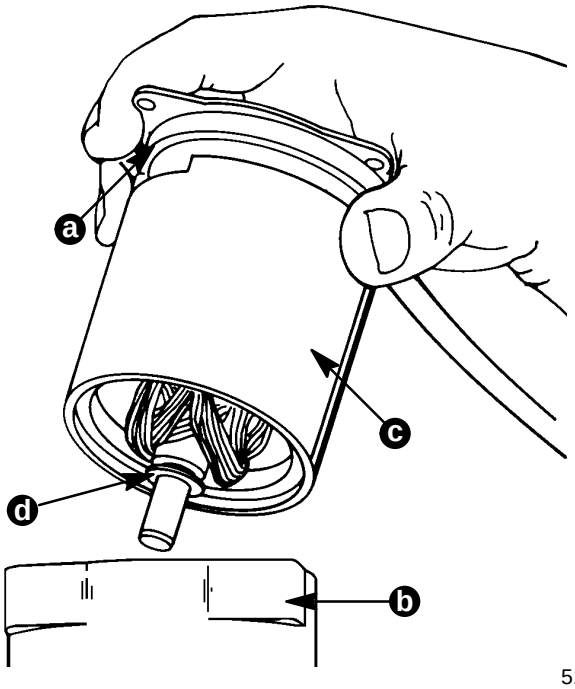
2. Lubricate end cap bushing with Quicksilver 2-4-C Lubricant and install armature and motor frame into end cap. As brushes contact commutator, release brush tension spring from ends of brush housings (returning springs to apply brush pressure to commutator). Install washer on each end of armature before installing armature into end cap (see inset).



51484

a - End Cap Bushing. Lubricate with Quicksilver 2-4-C Lubricant
b - Brush (2)
c - Commutator
d - Brush Tension Spring (2)

3. Guide armature and motor frame into reservoir housing as shown.

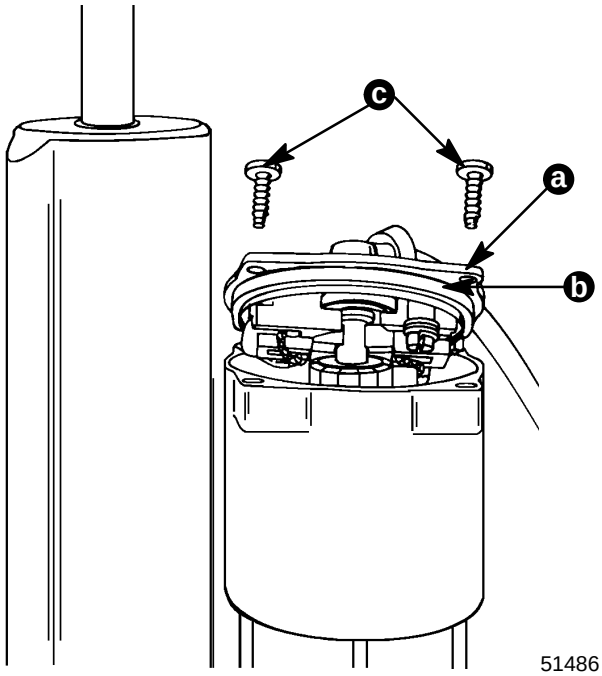


51485

a - End Cap
b - Motor Housing
c - Armature and Motor Frame
d - Washer (One Each End of Armature)

Reservoir Installation

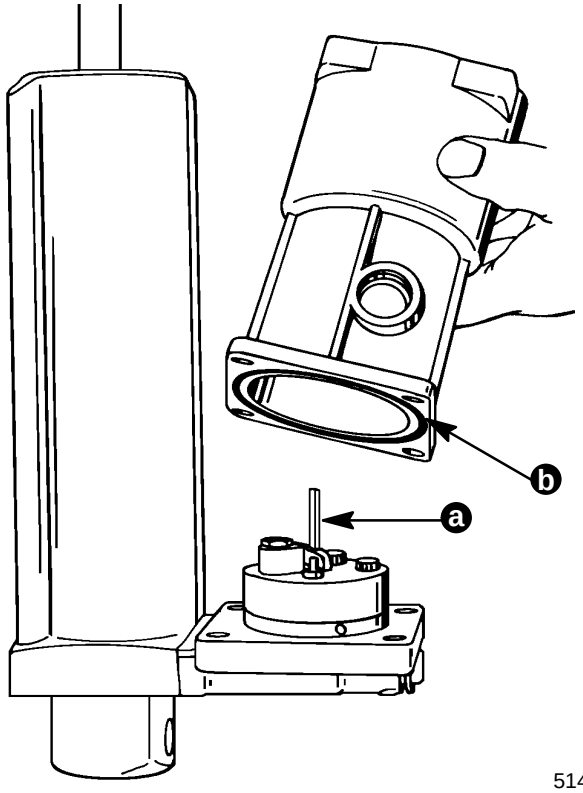
1. Torque end cap screws to 13 lb. ft. (1.5 N·m).



51486

a - End Cap
b - O-ring
c - Screws (4)

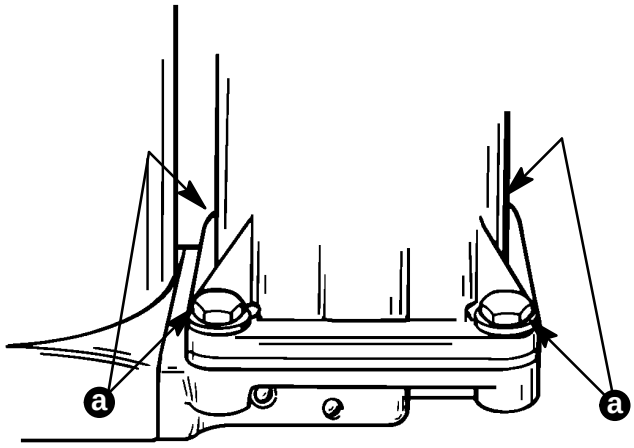
2. Place drive shaft into oil pump.
3. Install lubricated O-ring to base of reservoir.
4. Carefully guide (with motor) down onto drive shaft.



51486

a - Drive Shaft
b - O-ring

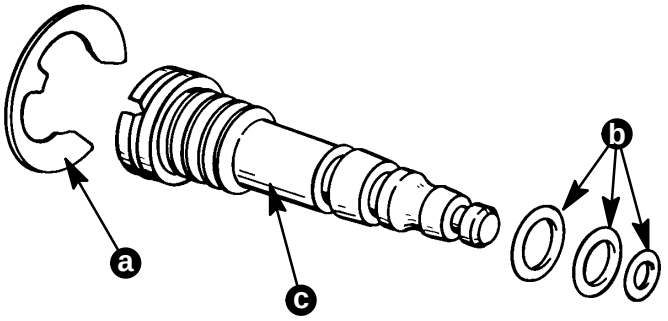
5. Secure reservoir to manifold using four screws. Torque screws to 70 lb. in. (7.7 N·m).



51193

a - Screws (4)

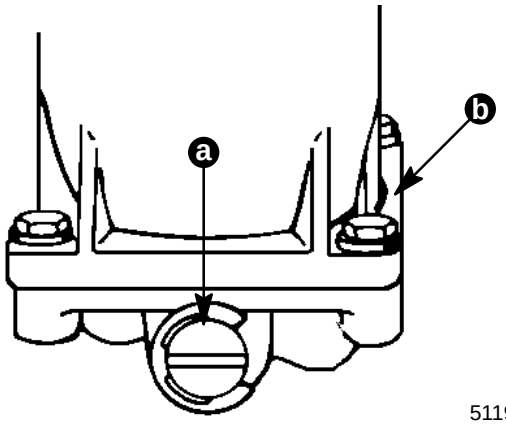
6. Install lubricated O-rings and “E” clip to manual release valve.



51196

a - “E” Clip
b - O-ring
c - Manual Release Valve

7. Insert manual release valve into manifold and tighten snuggly. Back release valve out 3 turns **maximum** allowing trim rod installation.

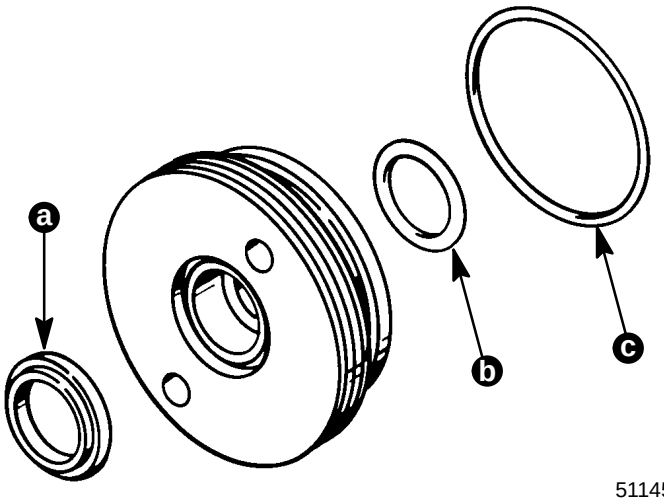


51194

a - Manual Release Valve
b - Manifold

Trim Rod Reassembly

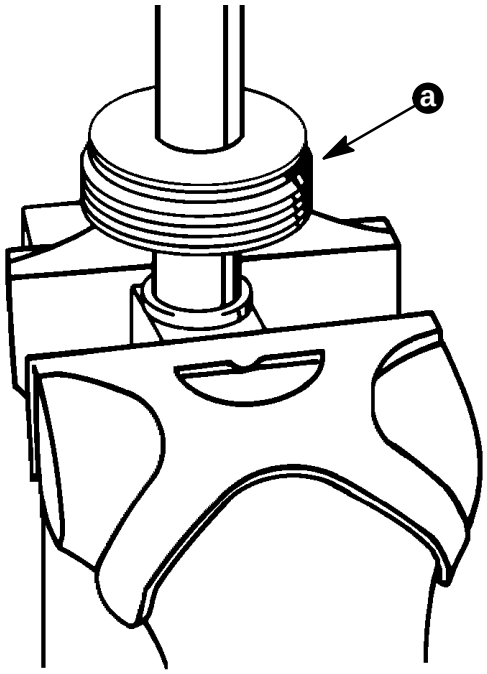
1. Install lubricated O-rings and rod wiper to end cap.



51145

a - Rod Wiper
b - Inner O-ring
c - Outer O-ring

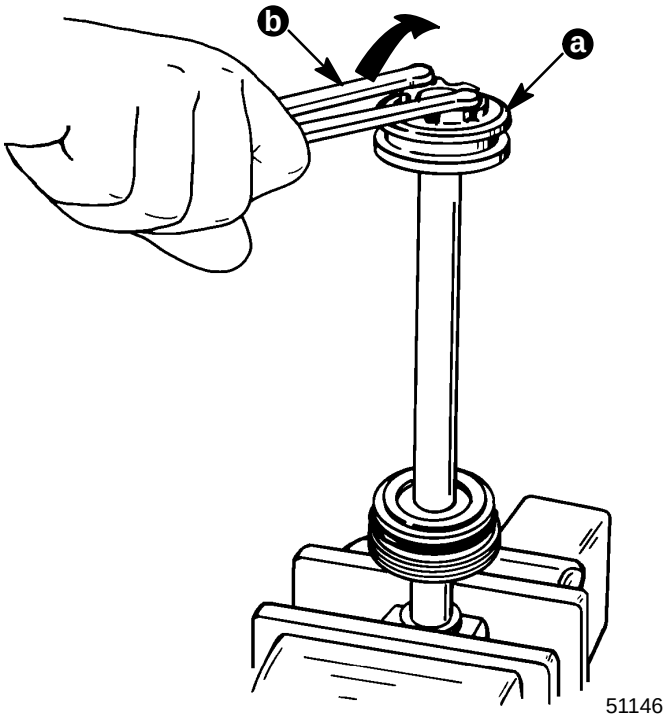
2. Secure trim rod in soft jawed vise as shown.
3. Slide end cap onto trim rod.



51146

a - End Cap

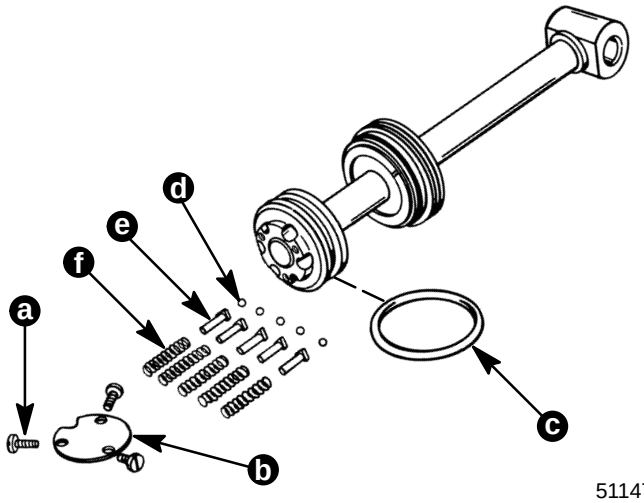
4. Apply Loctite Grade A (271) to threads of trim rod and install rod piston. Tighten piston securely using spanner wrench (1/4 in. x 5/16 in. long peg).



51146

a - Trim Rod Piston
b - Spanner Wrench

5. Install lubricated O-ring to trim rod piston.
6. Install check ball components into its respective bore.
7. Secure components in place using plate and screws. Torque screws to 35 lb. in. (4.0 N·m).



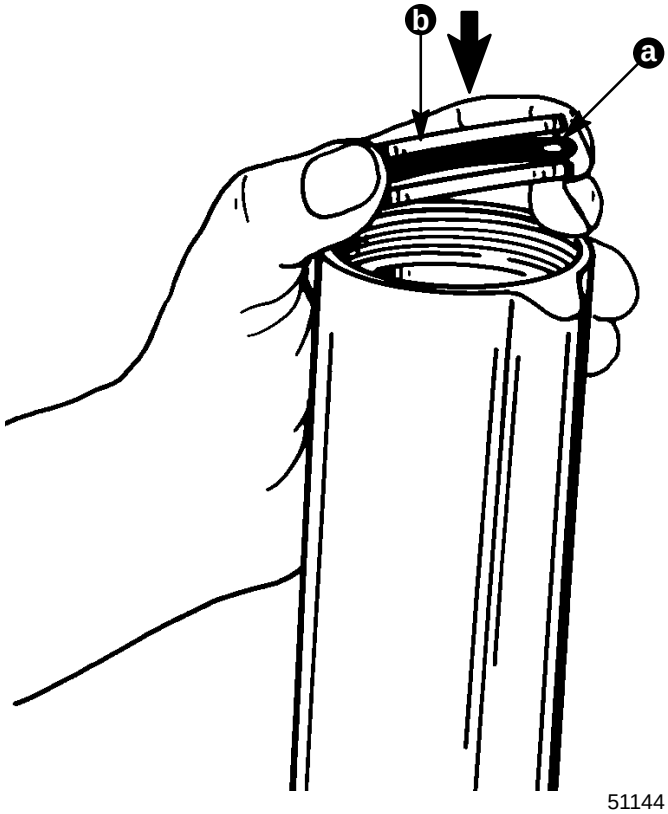
51147

a - Screw (3)
b - Plate
c - O-ring
d - Ball (5)
e - Seat, Spring (5)
f - Spring (5)

Trim Rod Installation

1. Place trim cylinder in soft jawed vise.
2. Fill trim cylinder three inches (76.2mm) from top of cylinder using Quicksilver Power Trim and Steering Fluid or; (ATF) Type F, FA or Dexron II.
3. Install lubricated O-ring to memory piston and place into cylinder. Push piston down to level of oil.

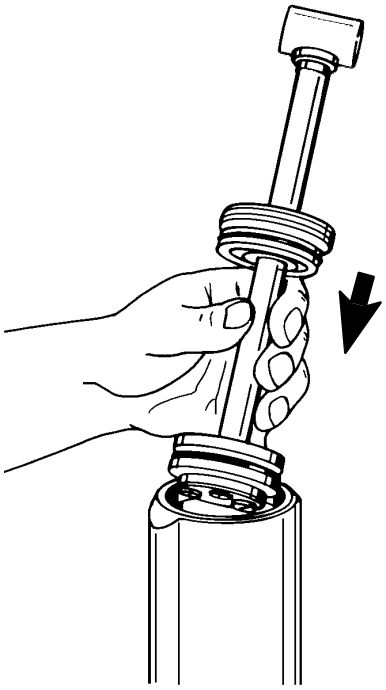
Memory piston must not contact end cap during trim rod/end cap installation.



51144

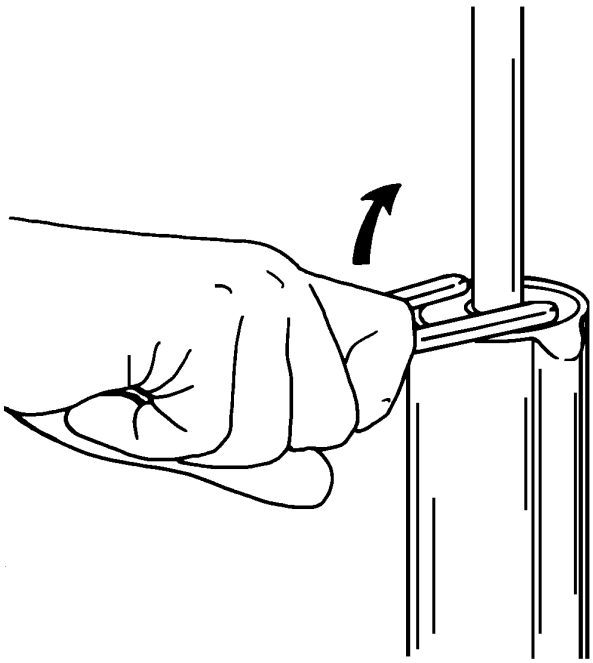
a - O-ring
b - Memory Piston

4. Install trim rod into cylinder.



51196

5. Tighten end cap assembly to cylinder securely using spanner wrench (1/4 in. x 5/16 in. long pegs).



51145

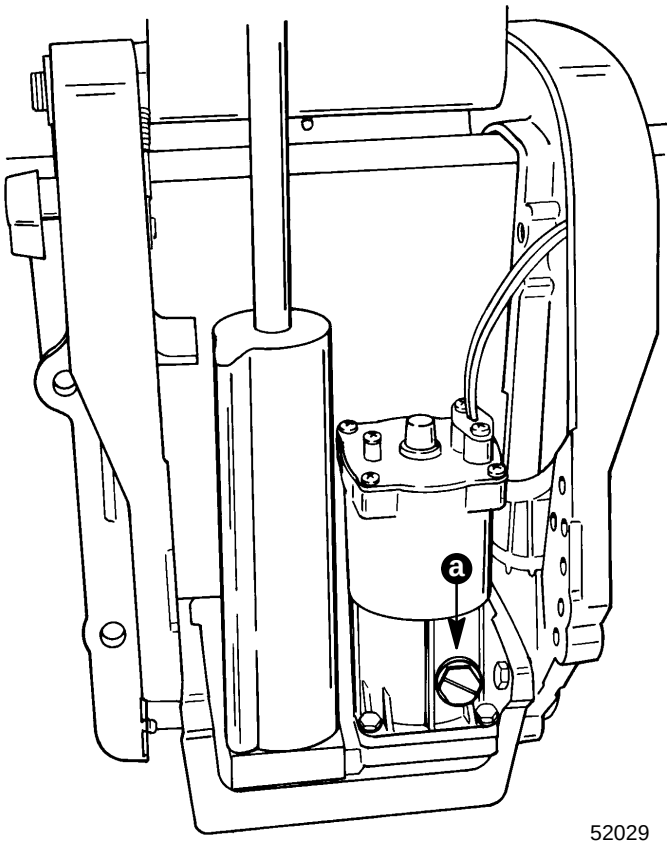
a - Spanner Wrench (P/N 91-74951)

6. Tighten manual release valve snuggly following end cap installation.

Purging Power Trim Unit

Manual release valve must be in full closed position during power trim purging and operation.

1. Secure power trim unit in soft jawed vise.
2. Remove fill cap (a). Add Quicksilver Power Trim and Steering Fluid (92-90100A12) or Automatic Transmission Fluid (ATF) Type F, FA or Dexron II up to threads of reservoir. Install cap (a).

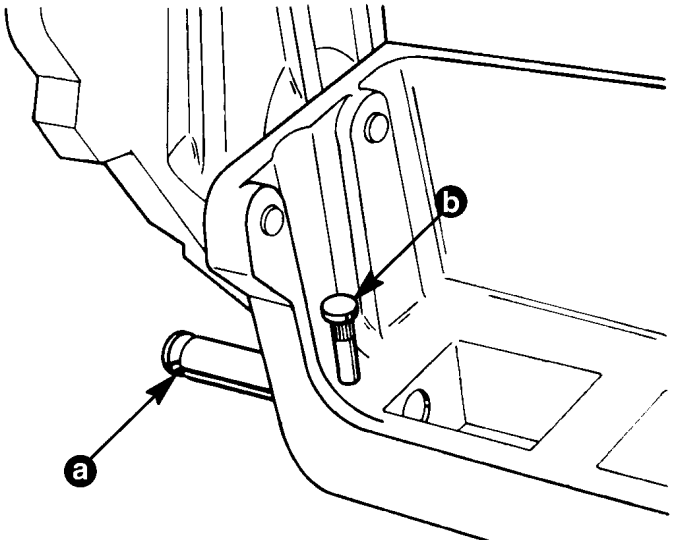


52029

3. Using a 12 volt power supply connect positive lead to green wire, negative lead to blue wire and drive trim rod to the down position. Connect positive lead to blue wire and negative lead to green wire and drive trim rod to the up position. Recheck fluid level, add fluid as required and repeat cycle until fluid level remains at lower portion of threads.

Power Trim Unit Installation

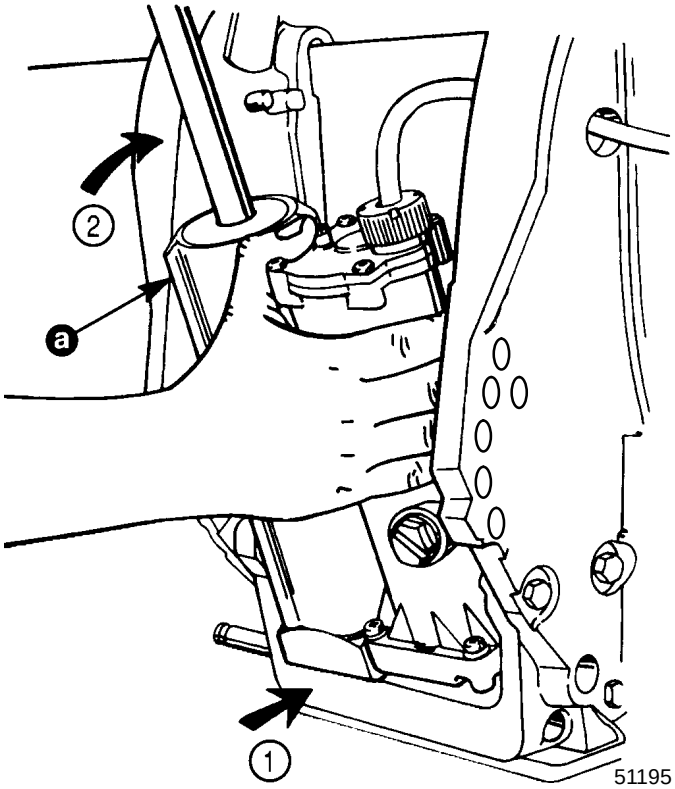
1. Apply Special Lubricant 101 (92-13872A1) to lower pivot pin bore and pivot pin surface.
2. Start lower pivot pin into pivot pin bore and position lower cross pin (RETAINED) in its respective hole.



51148

a - Lower Pivot Pin
b - Lower Dowel Pin

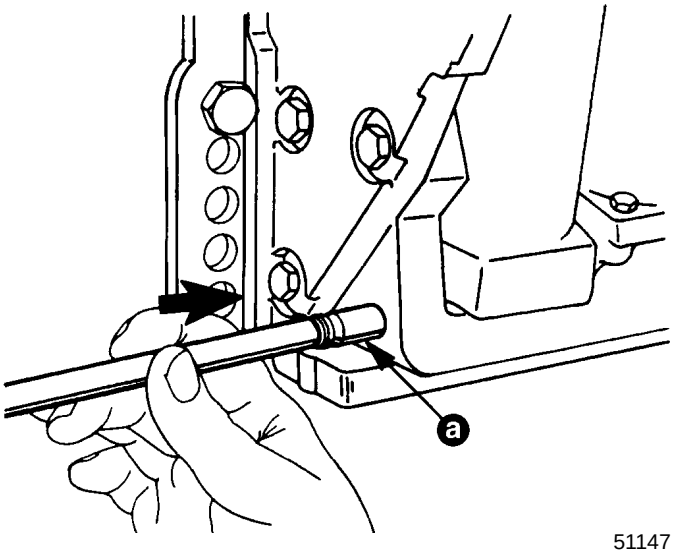
3. Position trim cylinder assembly (BOTTOM FIRST) between clamp brackets and route trim pump electrical harness through access hole in starboard clamp bracket.



51195

a - Trim Cylinder Assembly

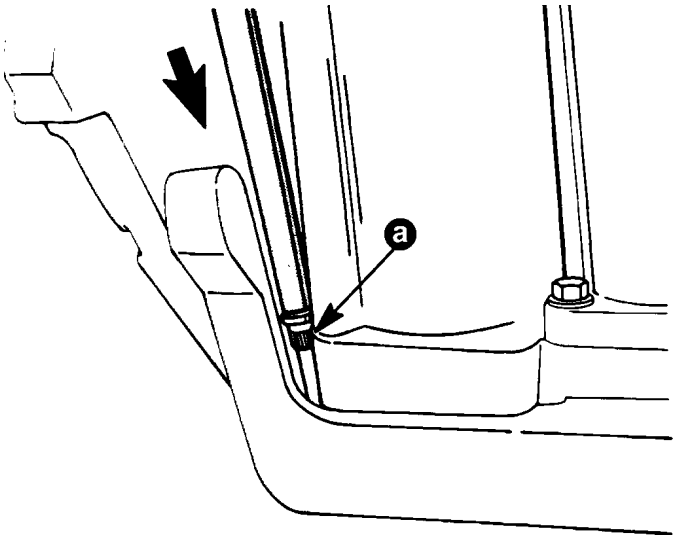
4. Using a suitable punch, drive lower pivot pin into clamp bracket and trim cylinder assembly until pivot pin is flush with outside surface.



51147

a - Lower Cross Pin

5. Using a suitable punch, drive lower pivot pin into clamp bracket and trim cylinder assembly until pivot pin is flush with outside surface.

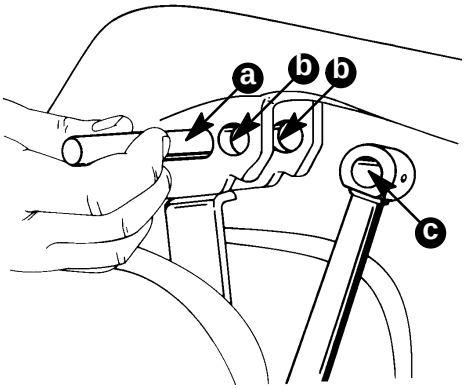


51148

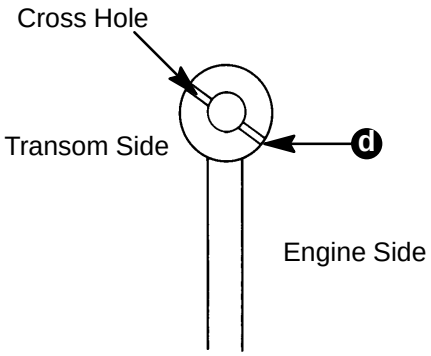
a - Lower Dowel Pin

6. Apply Special Lubricant (92-13872A1) to surface of upper pivot pin, pivot pin bore and trim ram bore.

NOTE: *Install trim ram with cross hole located as shown. If trim ram is installed reversed, the trim sender (if installed) will not operate.*

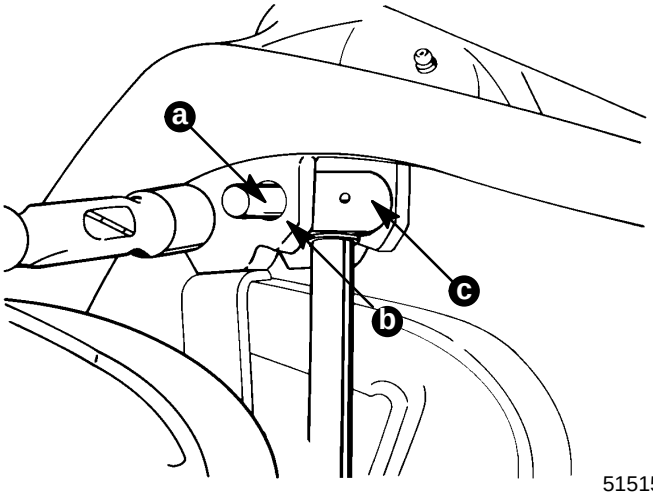


51515



a - Pivot Pin
b - Pivot Pin Bore
c - Trim Ram Bore
d - Install Trim Ram As Shown

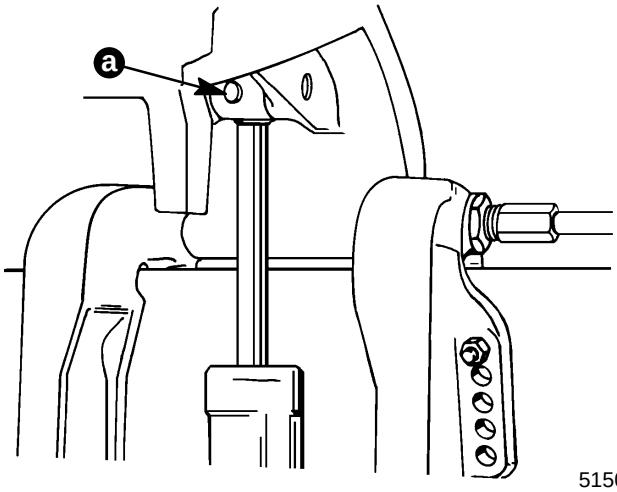
7. Using a suitable mallet, drive upper pivot pin into swivel bracket and through trim ram until pivot pin is flush with swivel bracket.



51515

a - Pivot Pin
b - Swivel Bracket
c - Trim Ram

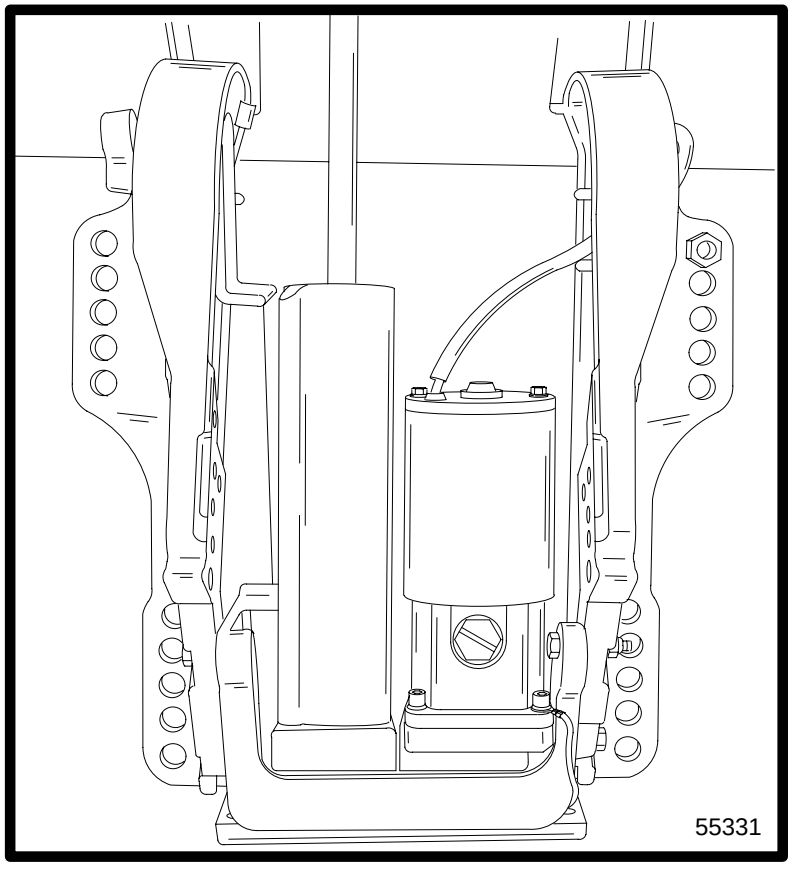
8. Drive upper retaining pin (a) in until seated.



51505

9. Recheck fluid level.
10. Power trim may now be operated to lower outboard to desired position. Trim system is self purging.
11. Reconnect power trim leads to relays under ignition cover.
12. Reinstall spark plug leads to spark plugs.
13. Reinstall cowls.
14. Connect battery leads to battery terminals.

MID-SECTION



POWER TRIM (DESIGN 4)

5

E

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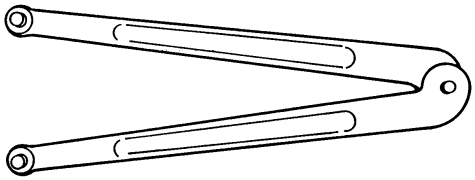
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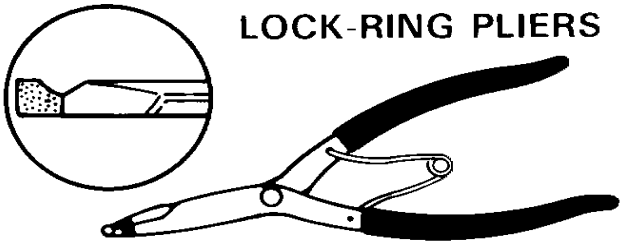
Installation of Power Trim System 5E-43

Special Tools

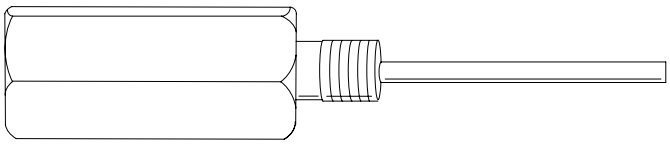
1. Spanner Wrench P/N 91-74951



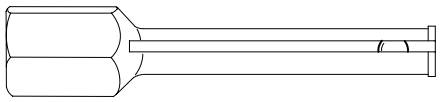
2. Lock-Ring Pliers P/N 91-822778A3



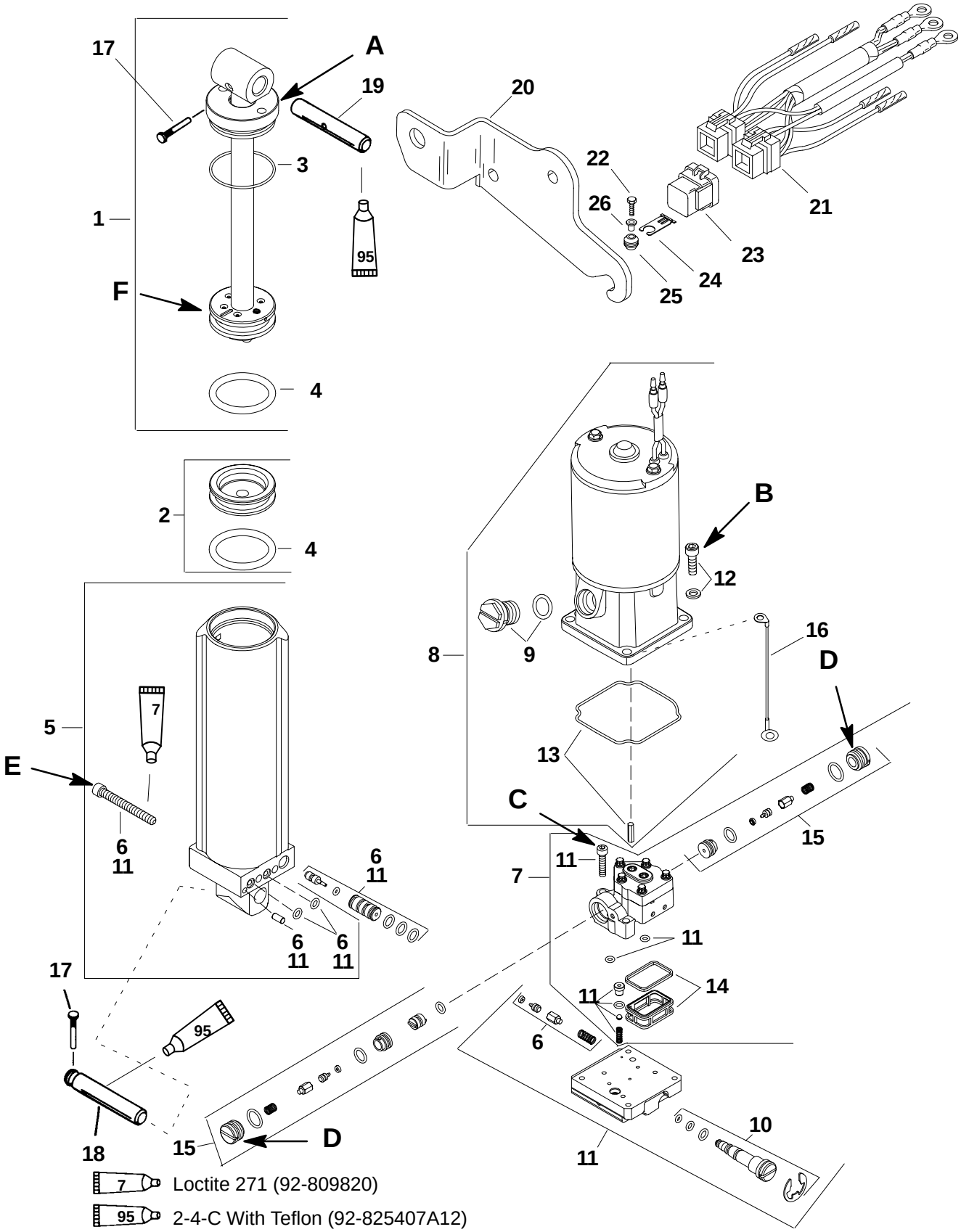
3. Expanding Rod P/N CG 41-11



4. Collet P/N CG 41-14



POWER TRIM COMPONENTS



NOTE: *Lubricate all O-rings using Quicksilver Power Trim and Steering Fluid. If not available, use automotive (ATF) automatic transmission fluid.*

NOTE: *It is recommended that all o-rings be replaced when servicing tilt system.*

POWER TRIM COMPONENTS

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
–	1	POWER TRIM PUMP			
1	1	SHOCK ROD KIT		45	61
2	1	MEMORY PISTON ASSEMBLY			
3	1	O RING REBUILD KIT			
4	2	O RING			
5	1	CYLINDER ASSEMBLY			
6	1	TRIM LIMIT VALVE KIT			
7	1	PUMP ASSEMBLY			
8	1	MOTOR KIT			
9	1	RESERVOIR PLUG	Drive Tight		
10	1	MANUAL RELEASE ASSEMBLY	Drive Tight		
11	1	MANIFOLD KIT			
12	1	SCREW KIT (MOTOR)	80		9.0
13	1	DRIVE SHAFT			
14	1	FILTER KIT			
15	1	P.O. CHECK ASSEMBLY KIT	120		13.5
16	1	CABLE			
–	1	O RING KIT (COMPLETE TRIM)			
17	2	GROOVE PIN			
18	1	ANCHOR PIN			
19	1	PIN			
20	1	BRACKET			
21	1	HARNESS-Trim			
22	2	SCREW (M6 x 25)			
23	2	RELAY			
24	2	BRACKET			
25	2	GROMMET			
26	2	BUSHING			

A – Torque cylinder cap to 45 lb. ft. (61 N·m)

B – Torque screws to 80 lb. in. (9.0 N·m)

C – Torque screws to 70 lb. in. (7.9 N·m)

D – Torque plugs to 120 lb. in. (13.5 N·m)

E – Torque screws to 100 lb. in. (11 N·m)

F – Torque shock piston to 90 lb. ft. (122 N·m)

Theory Of Operation

The Power Trim system consists of an electric motor, pressurized fluid reservoir, pump and trim cylinder.

The remote control (or trim panel) is equipped with a switch that is used for trimming the outboard “up” and “down”, and for tilting the outboard for shallow water operation (at slow speed), or for “trailering”. The outboard can be trimmed “up” or “down” while engine is under power or when engine is not running.

Adjustments

Trimming Characteristics

NOTE: *Because varying hull designs react differently in various degrees of rough water, it is recommended to experiment with trim positions to determine whether trimming “up” or “down” will improve the ride in rough water.*

When trimming your outboard from a mid-trim position (trim tab in neutral, straight fore-and-aft position), you can expect the following results:

TRIMMING OUTBOARD “UP” (“OUT”)

⚠ WARNING

Excessive trim “out” may reduce the stability of some high speed hulls. To correct instability at high speed, reduce the power gradually and trim the motor “In” slightly before resuming high speed operation. (Rapid reduction in power will cause a sudden change of steering torque and may cause additional momentary boat instability.

- Will lift bow of boat, generally increasing top speed.
- Transfers steering torque harder to left on installations below 23 in. transom height.
- Increases clearance over submerged objects.
- In excess, can cause porpoising and/or ventilation.
- In excess, can cause insufficient water supply to water pump resulting in serious water pump and/or powerhead overheating damage.

⚠ WARNING

Excessive engine trim angle will result in insufficient water supply to water pump causing water pump and/or powerhead overheating damage. Make sure that water level is above gear housing water intake holes whenever engine is running.

Operating “Up” circuit will actuate the “up” relay (located under engine cowl) and close the electric motor circuit. The electric motor will drive the pump, thus forcing automatic transmission fluid through internal passageways into the “up” side of the trim cylinder.

The trim cylinder/trim rod will position the engine at the desired trim angle within the 20° maximum trim range. The power trim system is designed so the engine cannot be trimmed beyond the 20° maximum trim angle as long as engine RPM is above approximately 2000 RPM.

The engine can be raised beyond the 20° maximum trim angle for shallow water operation, etc., by keeping the engine RPM below 2000 RPM. If engine RPM increases above 2000 RPM, the thrust created by the propeller (if deep enough in the water) will cause the trim system to automatically lower the engine back to the 20° maximum trim angle.

TRIMMING OUTBOARD “DOWN” (“IN”)

⚠ WARNING

Excessive speed at minimum trim “In” may cause undesirable and/or unsafe steering conditions. Each boat should be tested for handling characteristics after any adjustment is made to the tilt angle (tilt pin relocation).

- Will help planing off, particularly with a heavy load.
- Usually improves ride in choppy water.
- In excess, can cause boat to veer to the left or right (bow steer).
- Transfers steering torque harder to right (or less to the left).
- Improves planing speed acceleration (by moving tilt pin one hole closer to transom).

Operating “Down” circuit will actuate the “down” relay (located under engine cowl) and close the electric motor circuit (motor will run in opposite direction of the “Up” circuit). The electric motor will drive the pump, thus forcing automatic transmission fluid through internal passageways into the “down” side of the trim cylinder. The trim rod will move the engine downward to the desired angle.

Trailering Outboard

⚠ WARNING

Excessive engine trim angle will result in insufficient water supply to water pump causing water pump and/or powerhead overheating damage. Make sure that water level is above gear housing water intake holes whenever engine is running.

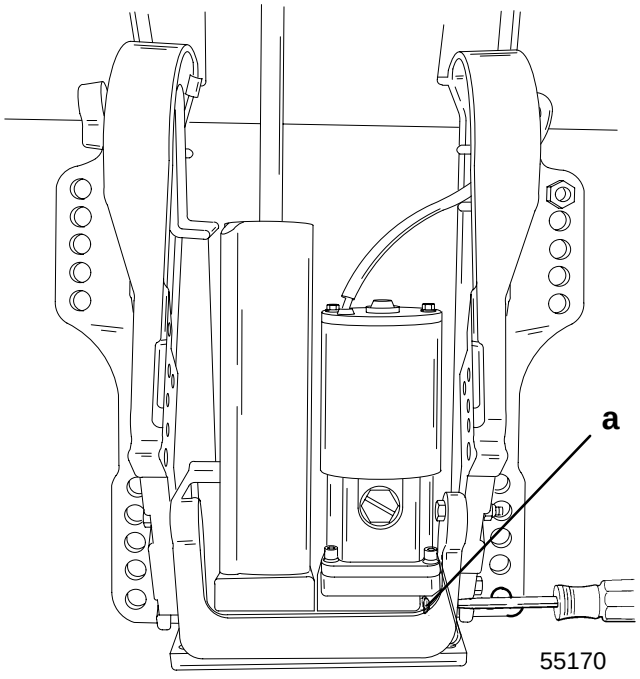
While operating “up” circuit, the cylinder rod will continue to tilt the outboard to a full “up” position for trailering.

Tilting Outboard Up and Down Manually

⚠ WARNING

Before loosening the manual release valve, make sure all persons are clear of engine as engine will drop to full “down” position when valve is loosened.

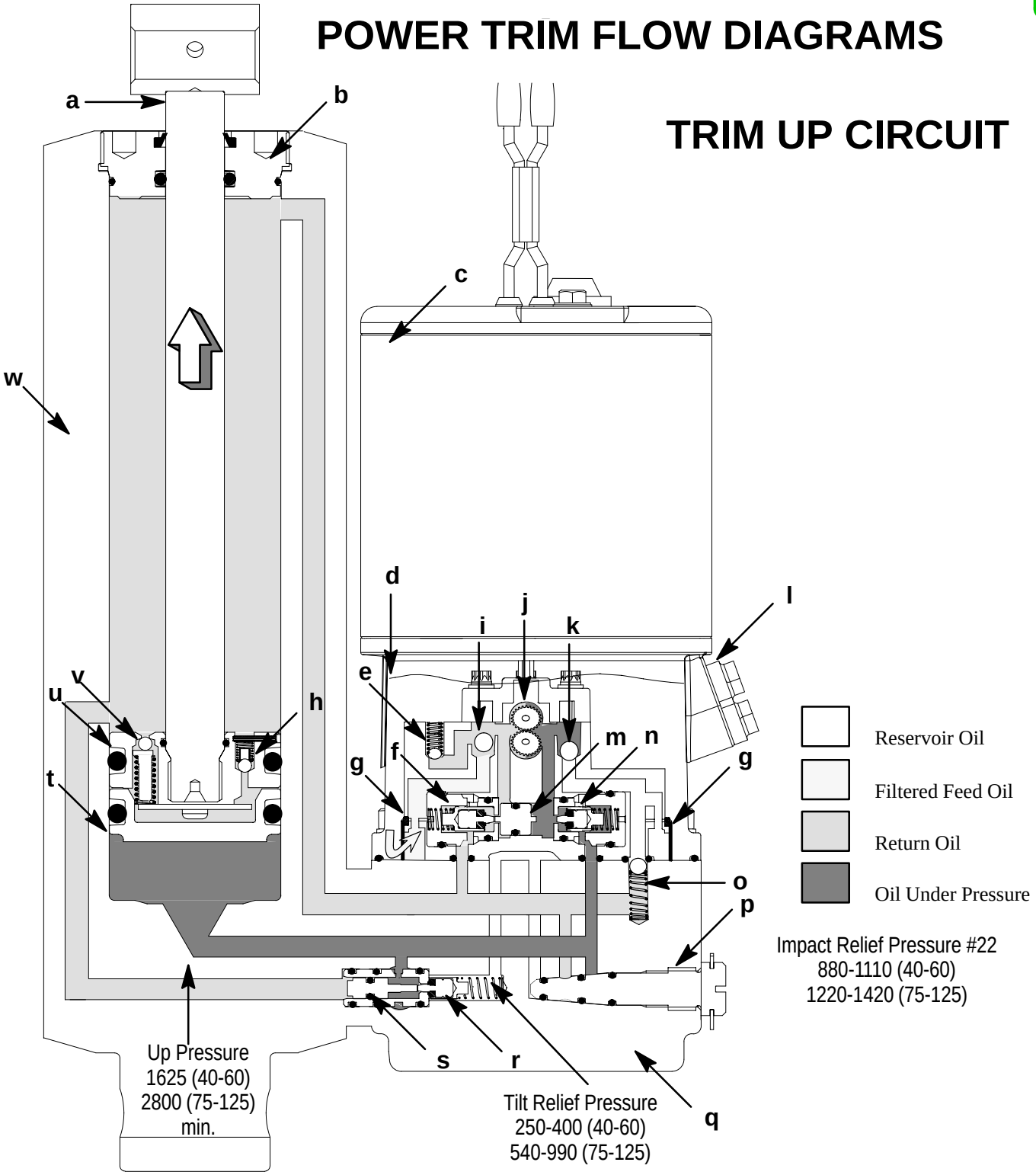
With power trim installed, the outboard can be raised or lowered manually by opening the manual release valve 3 to 4 turns (counterclockwise).



a - Manual Release Valve

POWER TRIM FLOW DIAGRAMS

TRIM UP CIRCUIT



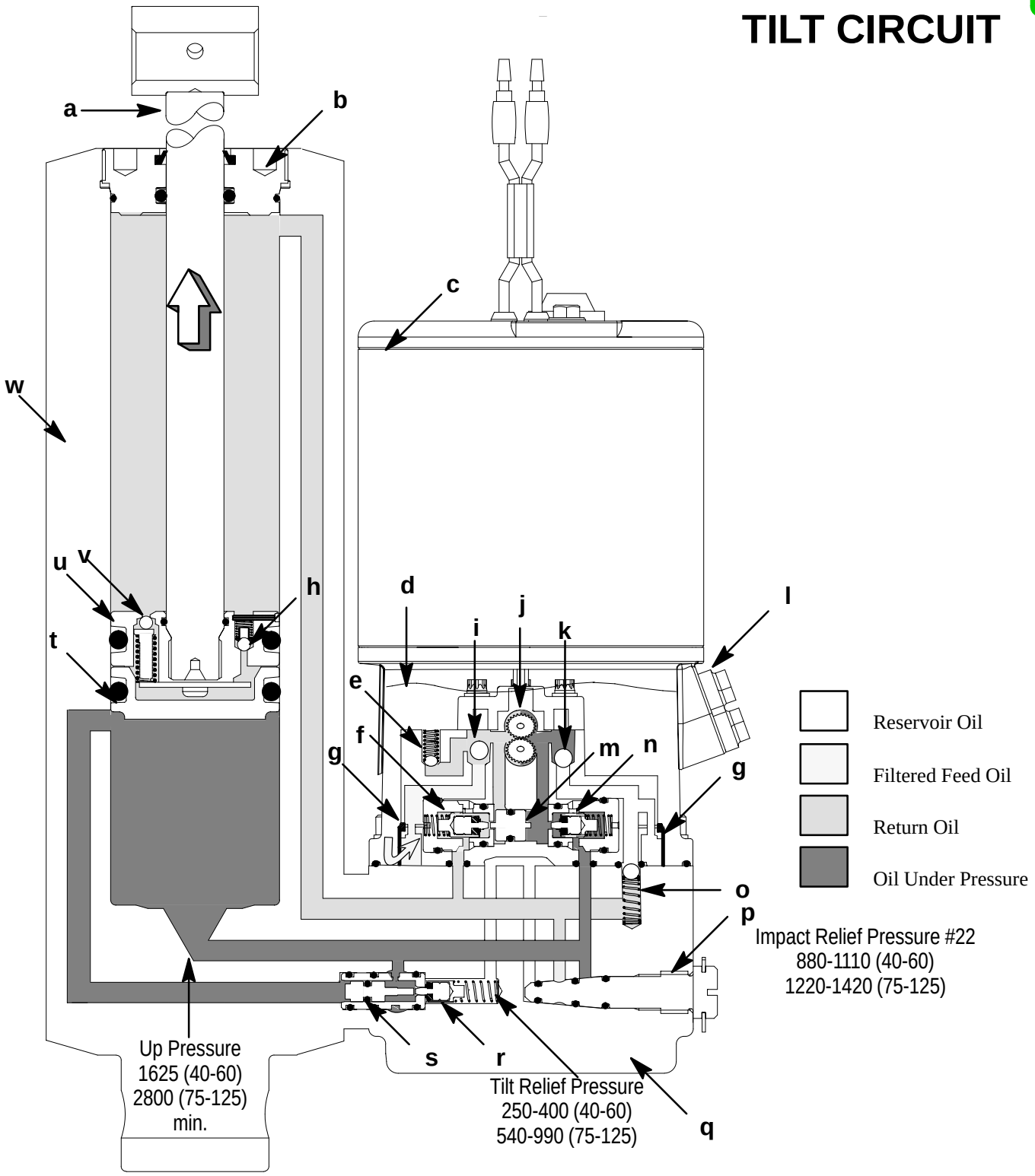
a - Piston Rod
b - End Cap
c - Electric Motor
d - Reservoir Oil
e - Down Pressure Regulating Valve
f - Down Pressure Operated Valve
g - Filter (2 shown for clarity)
h - Shock Return Valve
i - Up Circuit Suction Port
j - Oil Pump
k - Down Circuit Suction Port
l - Oil Fill Cap

m - Shuttle Valve
n - Up Pressure Operated Valve
o - Manifold Reverse Suction Valve
p - Manual Release Valve
q - Manifold
r - Tilt Relief Valve
s - Tilt Relief Piston
t - Memory Piston
u - Shock Piston
v - Impact Relief Valve
w - Cylinder

Trim Up

When the trim switch is activated in the “up” position, the electric motor (c) begins to rotate the pump gears (j), the oil pump draws a small amount of oil through the filter (g) and through the up circuit suction port (i). The oil pump gear (j) rotation forces oil into the passages for the up circuit. Oil, under pressure, will slide the shuttle valve (m) against the down circuit pressure operated valve (f). The shuttle valve will mechanically open the down pressure operated valve, allowing oil from the down cavity of the trim cylinder, to flow into the oil pump. This returning oil, from the down cavity, will supply most of the oil required for the up circuit. Oil in the up circuit is blocked from returning into the reservoir by the ball inside the down circuit suction port (k). The pressure of the oil will force the up circuit pressure operated valve (n) to open, allowing the oil to enter the passages inside the manifold (q) leading to the trim cylinder (w) up cavity. Oil is blocked from all other passages by the closed manual tilt valve (p). Oil under pressure will enter the trim cylinder below the memory piston (t). With an increasing amount of oil entering the cylinder, the memory piston contacts the shock piston (u) and forces the piston rod (a) up and out, raising the outboard motor. Oil on the top of the shock piston exits through a passage running down along the side of the cylinder and enters the manifold passages. The oil is drawn back into the pump (j) through the open down pressure operated valve (f) and enters the pump as supply for the up circuit.

TILT CIRCUIT



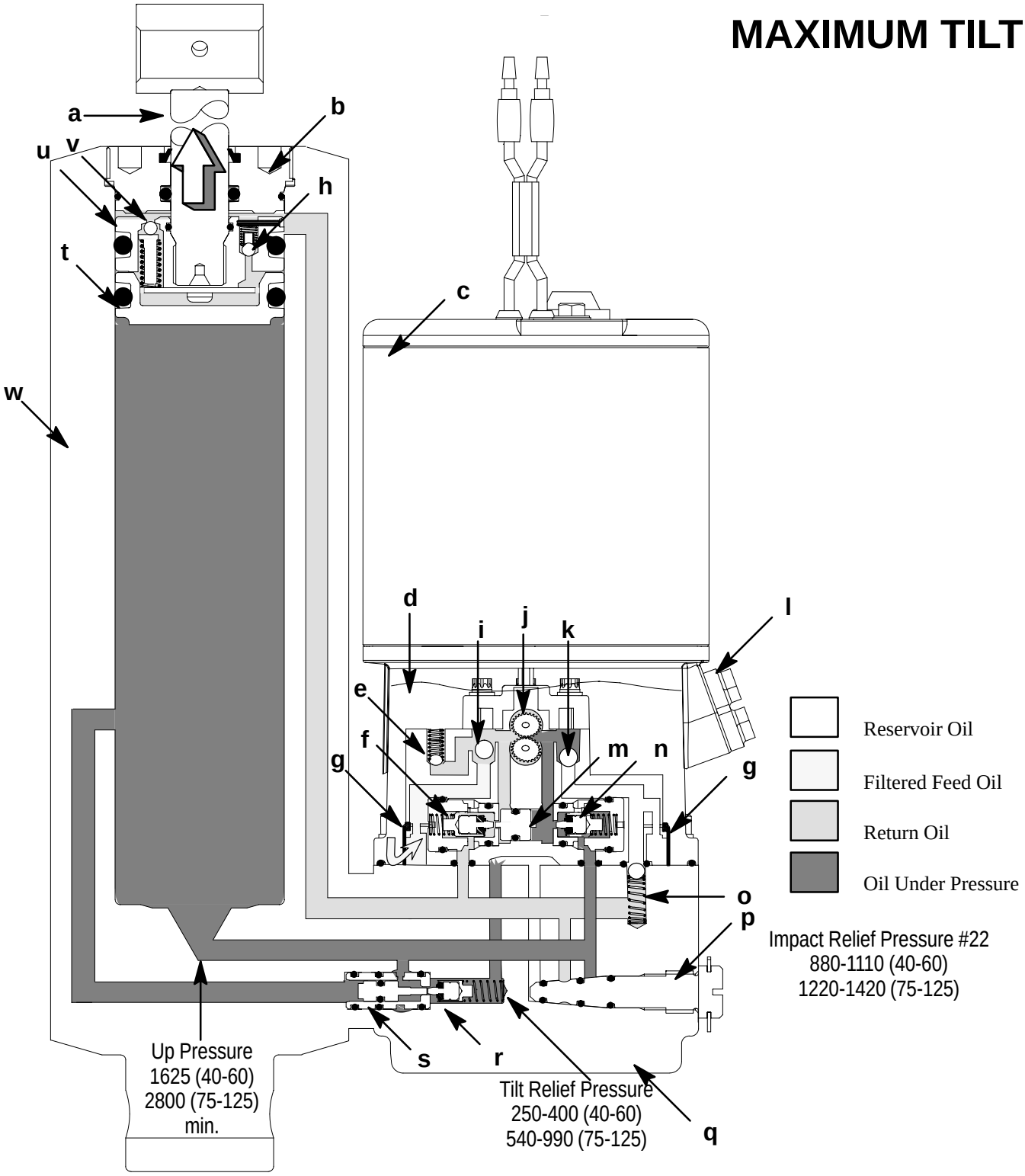
a - Piston Rod
b - End Cap
c - Electric Motor
d - Reservoir Oil
e - Down Pressure Regulating Valve
f - Down Pressure Operated Valve
g - Filter (2 shown for clarity)
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s - Tilt Relief Piston
t - Memory Piston
u - Shock Piston
v - Impact Relief Valve
w - Cylinder

Tilt Up

In the “up” mode, as the piston rod (a) extends from the cylinder (w), the memory piston (t) clears or uncovers the pressure relief passage. Oil from the up cavity will enter this passage and, if required, causes the tilt relief piston (s) to open the tilt pressure relief valve (r). This valve lowers the amount of pressure available to lift the outboard motor. With the engine in forward gear, and at high engine rpm, the oil pressure available will not be able to overcome the propeller thrust, limiting the trim range to below the pressure relief orifice. When the engine rpm’s fall or if engine is not in forward gear, the oil pressure is available to extend the piston rod (a) up into the tilt range.

MAXIMUM TILT



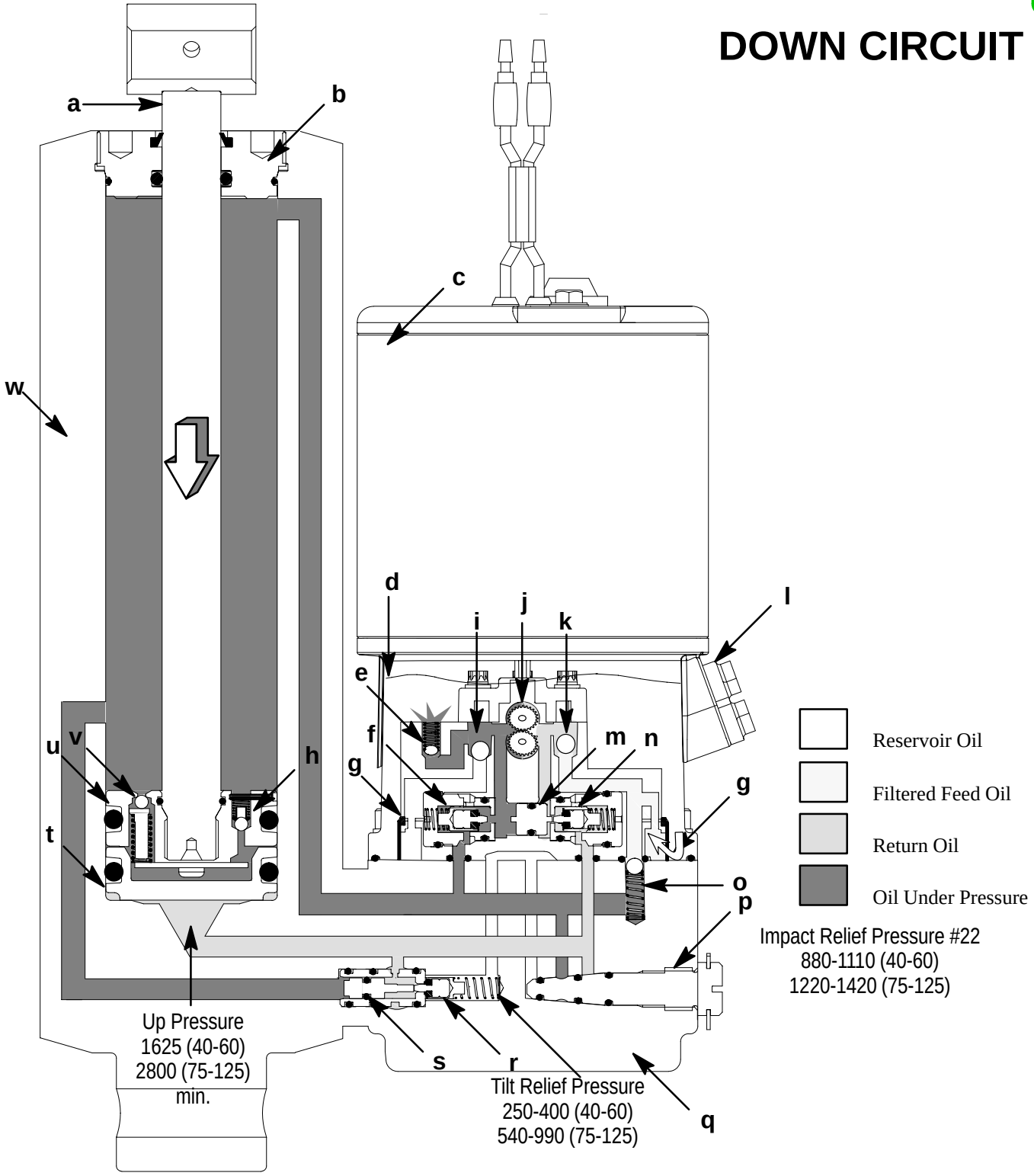
a - Piston Rod
b - End Cap
c - Electric Motor
d - Reservoir Oil
e - Down Pressure Regulating Valve
f - Down Pressure Operated Valve
g - Filter (2 shown for clarity)
h - Shock Return Valve
i - Up Circuit Suction Port
j - Oil Pump
k - Down Circuit Suction Port
l - Oil Fill Cap

m - Shuttle Valve
n - Up Pressure Operated Valve
o - Manifold Reverse Suction Valve
p - Manual Release Valve
q - Manifold
r - Tilt Relief Valve
s - Tilt Relief Piston
t - Memory Piston
u - Shock Piston
v - Impact Relief Valve
w - Cylinder

Maximum Tilt

With the piston rod at maximum travel, and due to no rod movement, the pressure inside of the trim cylinder (w) will increase to the pressure required to move the tilt relief piston (s). The tilt relief piston's "pin" opens the tilt relief valve (r). Up pressure flows into the trim relief passage, and returns back into the reservoir.

DOWN CIRCUIT



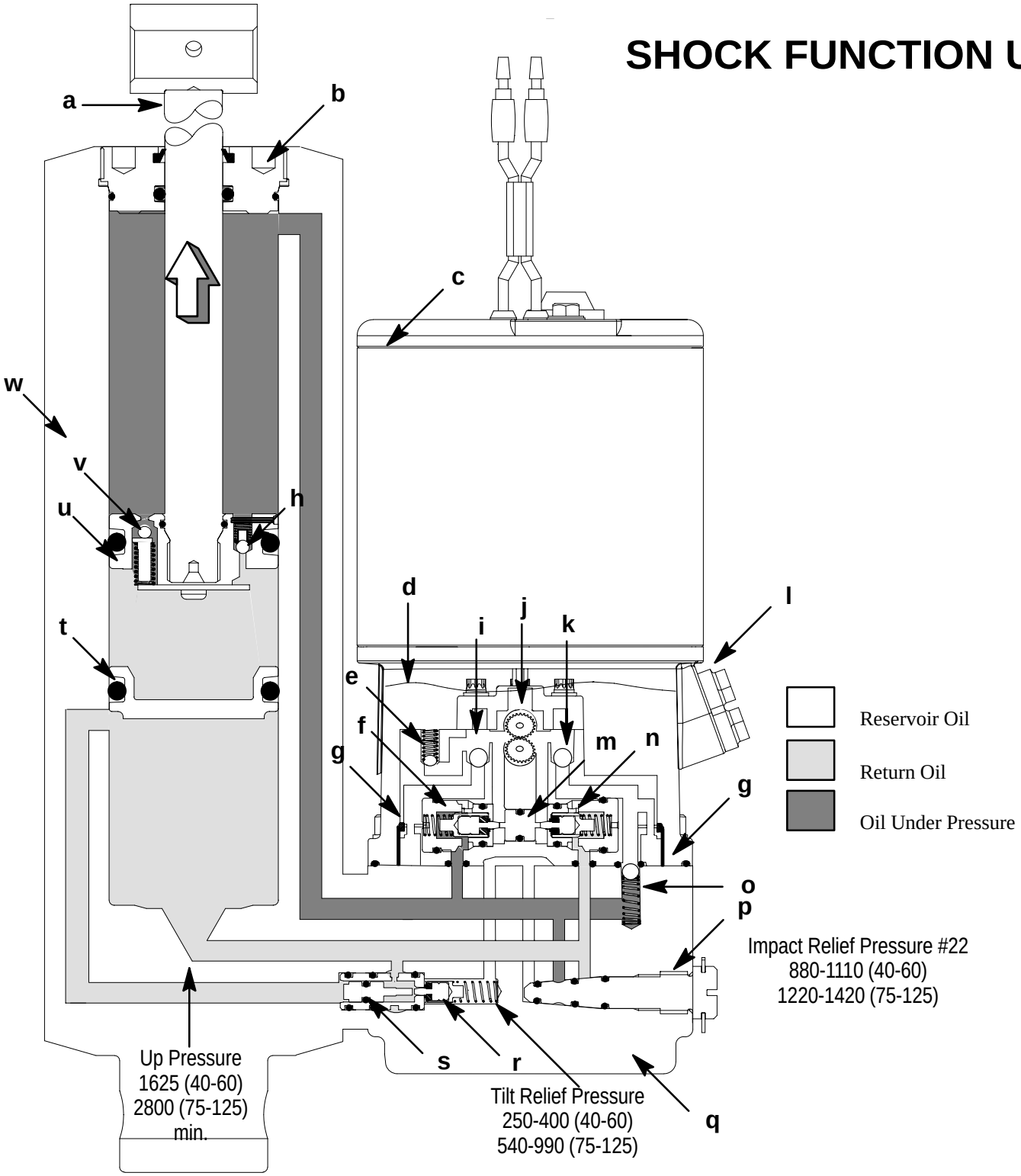
a - Piston Rod
b - End Cap
c - Electric Motor
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e - Down Pressure Regulating Valve
f - Down Pressure Operated Valve
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s - Tilt Relief Piston
t - Memory Piston
u - Shock Piston
v - Impact Relief Valve
w - Cylinder

Down Mode

When the trim switch is activated in the “down” position, the electric motor (c) will rotate the pump (j) in the opposite direction. With the pump gears rotating backwards, the flow of oil is reversed. Oil is drawn through the filter (g), through the down circuit suction port (k) and into the oil pump (j). The pump forces pressurized oil into the down passages, oil will slide the shuttle valve (m) into the up circuit pressure operated valve (n). The shuttle valve will mechanically open the up circuit pressure operated valve and allow oil, from the up cavity of the trim cylinder (w), to return into the oil pump. This returning oil, from the up cavity, will supply the oil required for the down circuit. The oil is blocked from returning into the reservoir by the ball inside the up circuit suction port (i). Oil, under pressure, opens the down pressure operated valve (f) and enters the down passages inside of the manifold (q). The manifold passage connects into the trim cylinder passage leading to the top of the cylinder. The cavity, inside the cylinder, above the shock piston (u) is the down cavity. As the down cavity fills with oil, the piston rod (a) retracts into the cylinder, lowering the outboard motor. Oil from the up cavity exits in the cylinder and is drawn back into the pump through the open up pressure operated valve (n). When the piston rod reaches full travel, the oil pressure inside the down circuit will rise until the down pressure relief valve (e) opens, bypassing oil back into the reservoir. When the trim button is released, and the oil pump stops supplying pressure, both of the pressure operated valves (f & n) will close and; if open, the down pressure regulating valve (e) will close. The closed valves will lock the fluid on either side of the shock piston (u) & memory piston (t), holding the outboard motor in position.

SHOCK FUNCTION UP



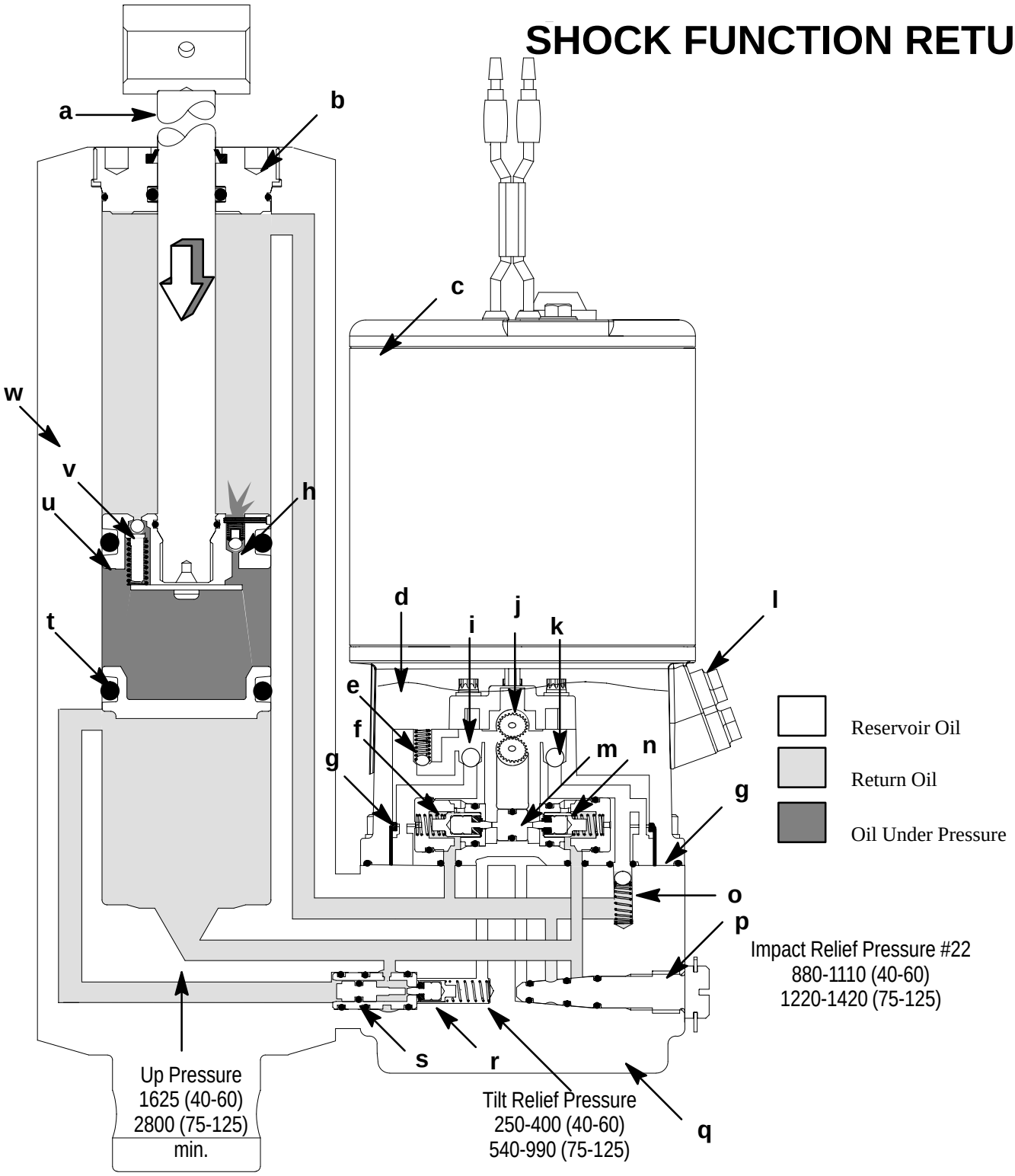
a - Piston Rod
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g - Filter (2 shown for clarity)
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m - Shuttle Valve
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q - Manifold
r - Tilt Relief Valve
s - Tilt Relief Piston
t - Memory Piston
u - Shock Piston
v - Impact Relief Valve
w - Cylinder

Shock Function Up

Oil inside the down cavity is locked in a static position by the closed pressure operated valve (f), the manual release valve (p) and the manifold reverse suction valve (o). If the outboard strikes an underwater object while in forward gear the piston rod (a) will try to rapidly extend from the cylinder (w), the pressure increases inside the trim cylinder down cavity and connecting passages. When the pressure increases to the level required, the impact relief valves (v), located inside the shock piston (u), will open and allow the fluid to pass through the shock piston. As the fluid passes through the piston, the piston rod (a) will extend from the trim cylinder. The memory piston (t) is held in position by vacuum, created by the oil in the up cavity being locked in a static position. Therefore; oil passing through the shock piston is trapped between the memory piston (t) and shock piston (u).

SHOCK FUNCTION RETURN



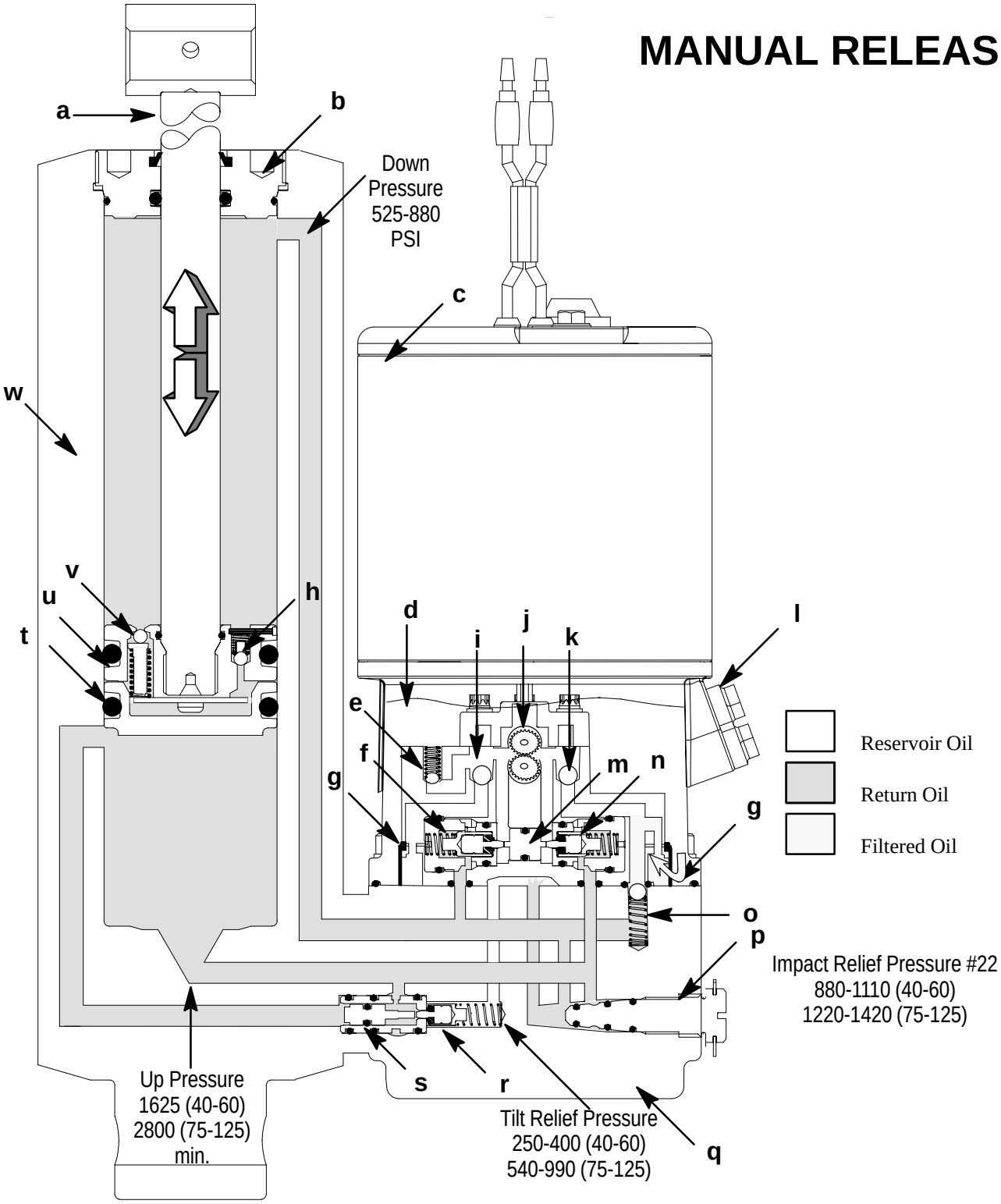
a - Piston Rod
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c - Electric Motor
d - Reservoir Oil
e - Down Pressure Regulating Valve
f - Down Pressure Operated Valve
g - Filter (2 shown for clarity)
h - Shock Return Valve
i - Up Circuit Suction Port
j - Oil Pump
k - Down Circuit Suction Port
l - Oil Fill Cap

m - Shuttle Valve
n - Up Pressure Operated Valve
o - Manifold Reverse Suction Valve
p - Manual Release Valve
q - Manifold
r - Tilt Relief Valve
s - Tilt Relief Piston
t - Memory Piston
u - Shock Piston
v - Impact Relief Valve
w - Cylinder

Shock Function Return

After the engine clears the under water object, the weight of the engine will increase the oil pressure between the memory piston (t) and shock piston (u) to the level required to open the shock return valve (h), inside the shock piston, allowing the oil to bleed back through the shock piston into the down cavity. If required, additional oil will enter the down cavity through the manifold reverse suction valve (o). This will return the engine back against the memory piston (t) and into the original running position.

MANUAL RELEASE



a - Piston Rod
b - End Cap
c - Electric Motor
d - Reservoir Oil
e - Down Pressure Regulating Valve
f - Down Pressure Operated Valve
g - Filter (2 shown for clarity)
h - Shock Return Valve
i - Up Circuit Suction Port
j - Oil Pump
k - Down Circuit Suction Port
l - Oil Fill Cap

m - Shuttle Valve
n - Up Pressure Operated Valve
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p - Manual Release Valve
q - Manifold
r - Tilt Relief Valve
s - Tilt Relief Piston
t - Memory Piston
u - Shock Piston
v - Impact Relief Valve
w - Cylinder

Manual Tilt

To manually tilt the outboard engine, the owner will need to back out the manual release valve (p) 3-4 turns. With the valve backed out, the internal passages inside the manifold are connected together. These passages connect both the cylinder down and up cavities together, along with the reservoir, allowing the engine to be raised or lowered. Piston rod (a) movement will continue until the manual release valve (p) is closed, locking the fluid inside of the cylinder and manifold.

Troubleshooting

Support outboard with tilt lock pin when servicing power trim system.

IMPORTANT: After debris or failed components have been found (during troubleshooting procedure) it is recommended that unit be disassembled completely and ALL O-rings be replaced. Check ball valve components and castings must be cleaned using engine cleaner and compressed air or replaced prior to re-assembly.

IMPORTANT: Power trim system is pressurized. Outboard must be in the full "UP" position (trim rod fully extended) prior to fill/drain plug or manual release valve removal.

Refer to instructions following if disassembly is required when servicing.

Follow preliminary checks before proceeding to troubleshooting flow diagrams (following).

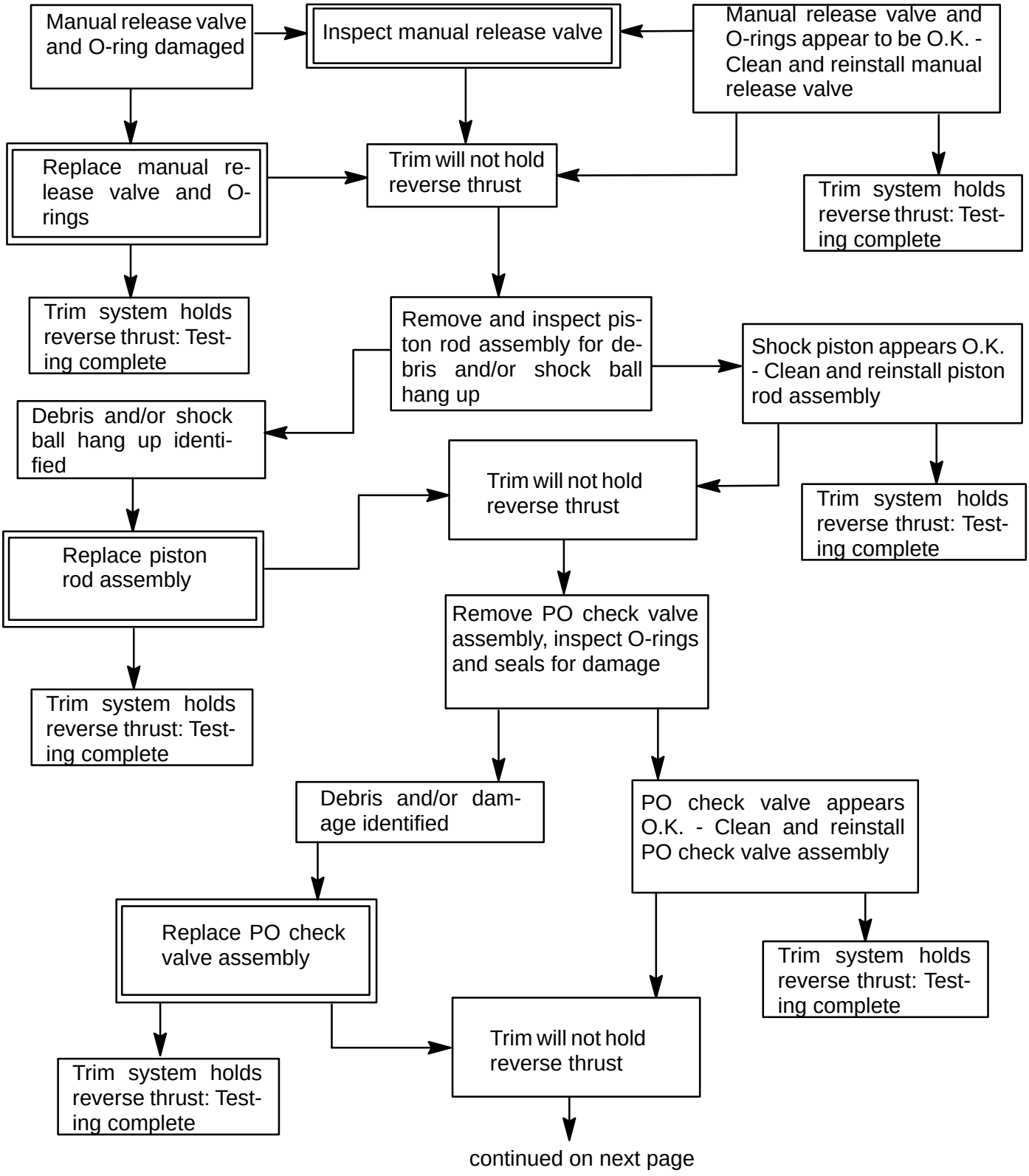
Preliminary Checks

IMPORTANT: Operate Power Trim system after each check to see if problem has been corrected. If problem has not been corrected, proceed to next check.

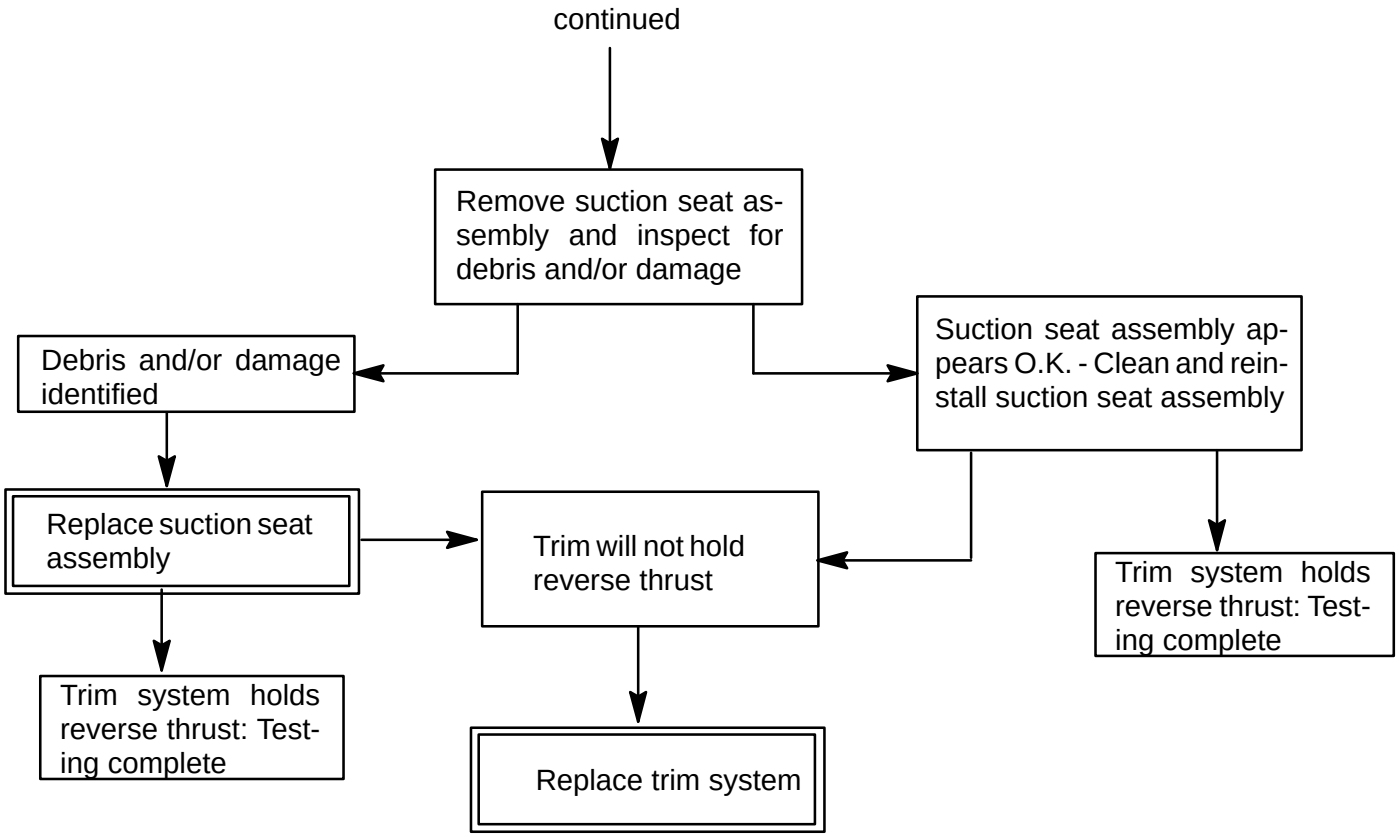
1. Check that manual release valve is tightened to full right (clockwise) position.
2. Check trim pump fluid level with outboard in full "UP" position and fill if necessary. Refer to "Bleeding Power Trim Unit".
3. Check for external leaks in Power Trim system. Replace defective part(s) if leak is found.
4. Outboard not holding tilted position (falls down to trim position) indicates debris or defective components in trim assembly. Clean or replace components as required.

Hydraulic System Troubleshooting Flow Chart

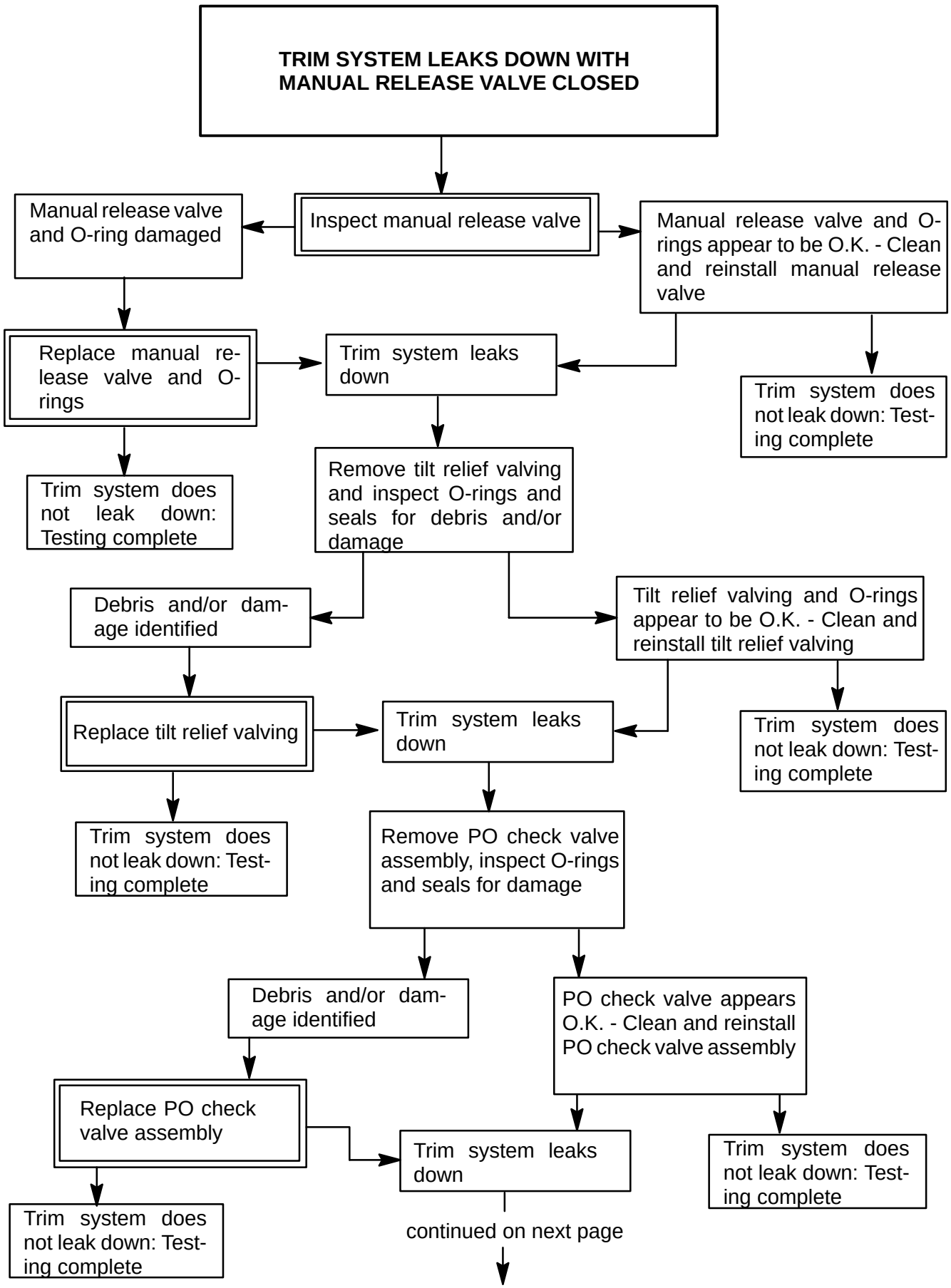
OUTBOARD WILL NOT HOLD TILTED POSITION DURING REVERSE AND/OR TRAILS OUT DURING HIGH SPEED DECELERATION


Manual release valve and O-ring damaged
Inspect manual release valve
Manual release valve and O-rings appear to be O.K. - Clean and reinstall manual release valve
Replace manual release valve and O-rings
Trim will not hold reverse thrust
Trim system holds reverse thrust: Testing complete
Trim system holds reverse thrust: Testing complete
Remove and inspect piston rod assembly for debris and/or shock ball hang up
Shock piston appears O.K. - Clean and reinstall piston rod assembly
Debris and/or shock ball hang up identified
Trim will not hold reverse thrust
Trim system holds reverse thrust: Testing complete
Replace piston rod assembly
Remove PO check valve assembly, inspect O-rings and seals for damage
Trim system holds reverse thrust: Testing complete
Debris and/or damage identified
PO check valve appears O.K. - Clean and reinstall PO check valve assembly
Replace PO check valve assembly
Trim system holds reverse thrust: Testing complete
Trim will not hold reverse thrust
Trim system holds reverse thrust: Testing complete
continued on next page

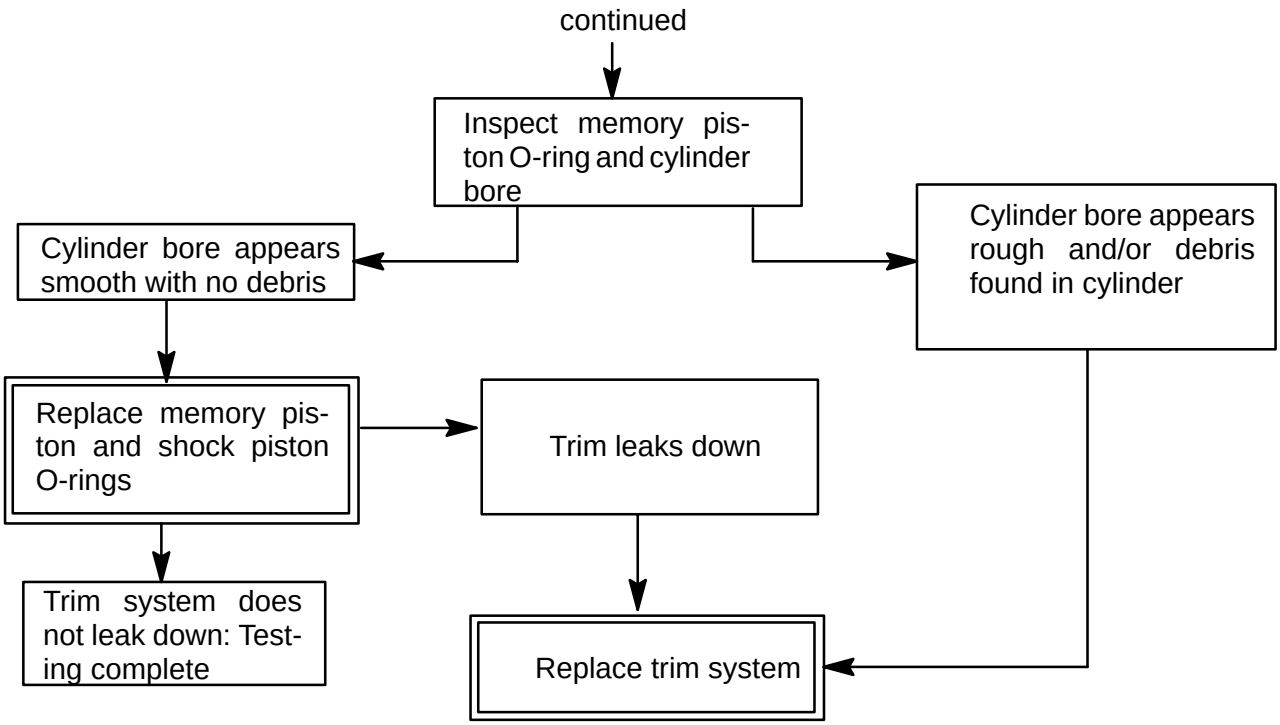
Hydraulic System Troubleshooting Flow Chart


continued
Remove suction seat assembly and inspect for debris and/or damage
Debris and/or damage identified
Suction seat assembly appears O.K. - Clean and reinstall suction seat assembly
Replace suction seat assembly
Trim will not hold reverse thrust
Trim system holds reverse thrust: Testing complete
Trim system holds reverse thrust: Testing complete
Replace trim system

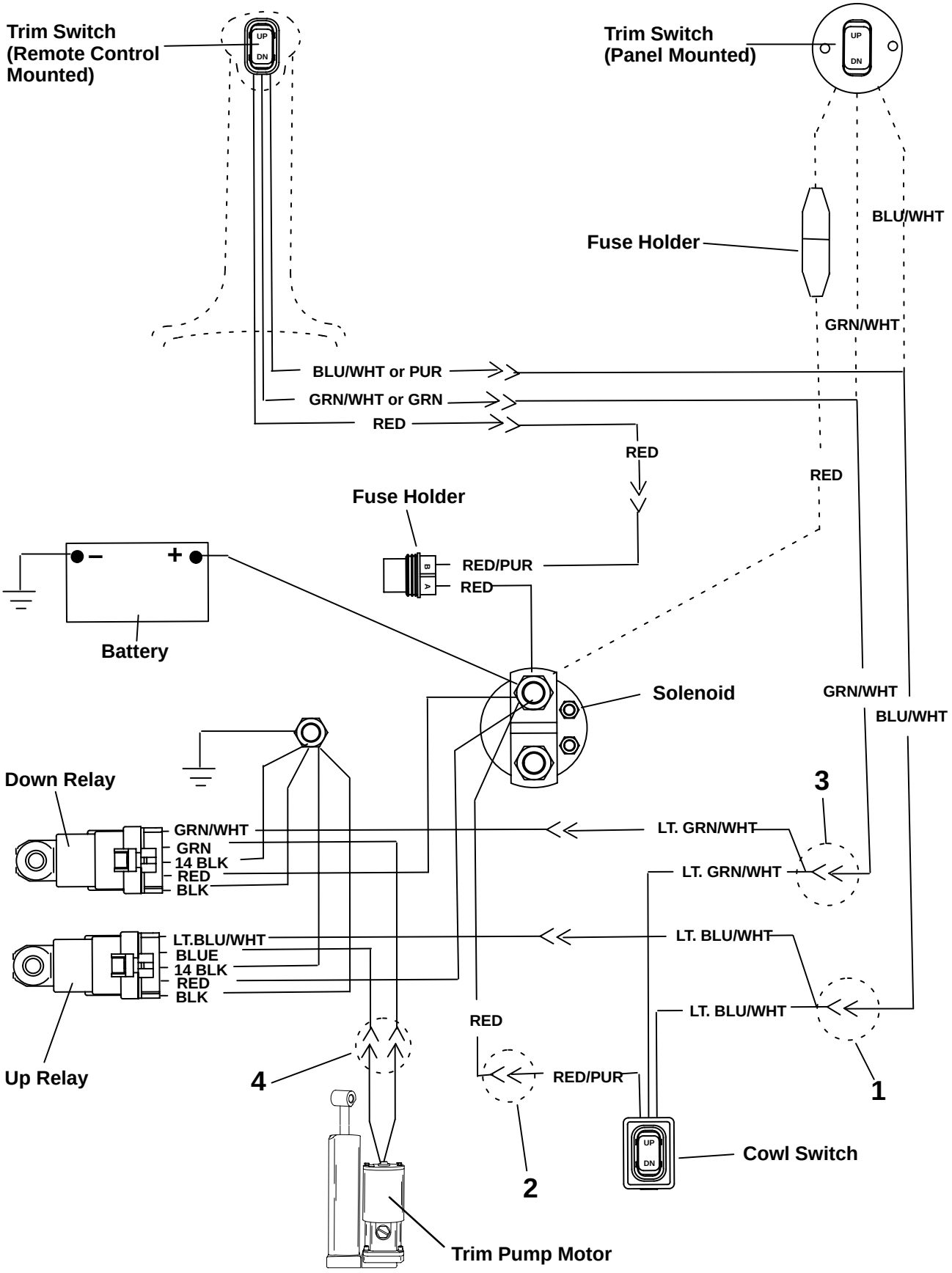
Hydraulic System Troubleshooting Flow Chart


TRIM SYSTEM LEAKS DOWN WITH MANUAL RELEASE VALVE CLOSED
Inspect manual release valve
Manual release valve and O-ring damaged
Manual release valve and O-rings appear to be O.K. - Clean and reinstall manual release valve
Replace manual release valve and O-rings
Trim system leaks down
Trim system does not leak down: Testing complete
Trim system does not leak down: Testing complete
Remove tilt relief valving and inspect O-rings and seals for debris and/or damage
Debris and/or damage identified
Tilt relief valving and O-rings appear to be O.K. - Clean and reinstall tilt relief valving
Replace tilt relief valving
Trim system leaks down
Trim system does not leak down: Testing complete
Trim system does not leak down: Testing complete
Remove PO check valve assembly, inspect O-rings and seals for damage
Debris and/or damage identified
PO check valve appears O.K. - Clean and reinstall PO check valve assembly
Replace PO check valve assembly
Trim system leaks down
Trim system does not leak down: Testing complete
Trim system does not leak down: Testing complete
continued on next page

Hydraulic System Troubleshooting Flow Chart


continued
Inspect memory piston O-ring and cylinder bore
Cylinder bore appears smooth with no debris
Cylinder bore appears rough and/or debris found in cylinder
Replace memory piston and shock piston O-rings
Trim leaks down
Trim system does not leak down: Testing complete
Replace trim system

Troubleshooting the Power Trim Electrical System



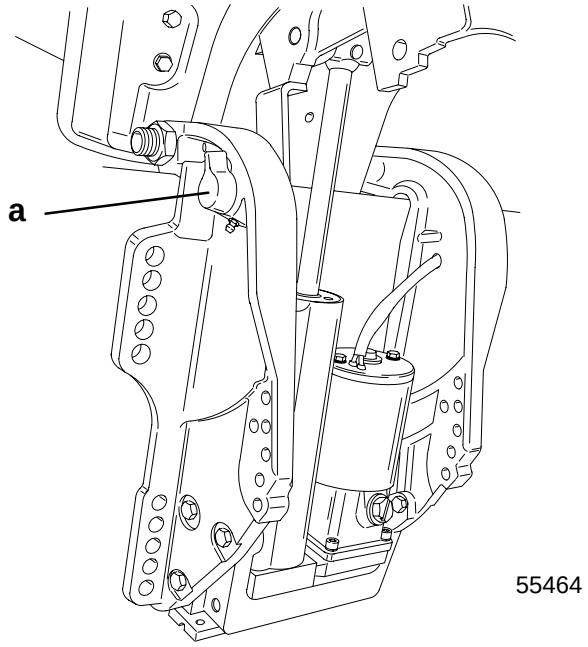
Troubleshooting the Power Trim Electrical System

Refer to wiring diagram on preceding page for location of wire connections.

Problem	Possible Cause	Remedy
Trim Switch “UP” is inoperative, but the Cowl Switch “UP” does operate.	1. Open wire between Wire Connection (1) and Trim Switch. 2. Faulty Trim Switch.	1. Check for an open connection or cut wire. 2. Replace.
Cowl Switch “UP” is inoperative, but the Trim Switch “UP” does operate.	1. Open wire between Wire Connection (2) and Solenoid. 2. Faulty Cowl Switch.	1. Check for an open connection or cut wire. 2. Replace.
Trim Switch “UP” and Cowl Switch “UP” are both inoperative.	1. Open wire between Wire Connection (1) and the Up Relay. 2. Open BLK wire between ground and UP Relay. 3. Open RED wire between Solenoid and Up Relay. 4. Faulty Up Relay .	1. Check for an open connection. 2. Check for an open connection. 3. Check for an open connection. 4. Replace.
Trim Switch “DOWN” is inoperative, but the Cowl Switch “DOWN” does operate.	1. Open wire between Wire Connection (3) and Trim Switch. 2. Faulty Trim Switch.	1. Check for an open connection or cut wire. 2. Replace.
Cowl Switch “DOWN” is inoperative, but the Trim Switch “DOWN” does operate.	1. Open wire between Wire Connection (2) and Solenoid. 2. Faulty Cowl Switch.	1. Check for an open connection or cut wire. 2. Replace.
Trim Switch “DOWN” and Cowl Switch “DOWN” are both inoperative.	1. Open wire between Wire Connection (3) and the Up Relay. 2. Open BLK wire between ground and Down Relay. 3. Open RED wire between Solenoid and Down Relay. 4. Faulty Down Relay	1. Check for an open connection. 2. Check for an open connection. 3. Check for an open connection. 4. Replace.
Trim Switch “UP” and “DOWN” are both inoperative, but the Cowl Switch does operate.	1. 20 AMP Fuse blown. 2. Faulty trim switch. 3. Wire is open between fuse holder and solenoid. 4. Wire is open between fuse holder and trim switch.	1. Replace fuse. Locate the cause of the blown fuse. Check electrical wiring for a shorted circuit. 2. Replace 3. Check for an open connection or cut wire. 4. Check for a loose or corroded connection.
Trim Switch and Cowl Switch are both inoperative.	1. One of the Trim Pump Motor wires is open between the motor and the Relays. 2. Faulty trim pump motor.	1. Check wire connections (4) for loose or corroded condition. 2. If voltage is present at connections (4) when the appropriate trim button is pressed, then motor is faulty. Replace motor.
Trim system operates (motor runs) without pressing the switches.	1. The Trim or Cowl switch is shorted.	1. Replace.

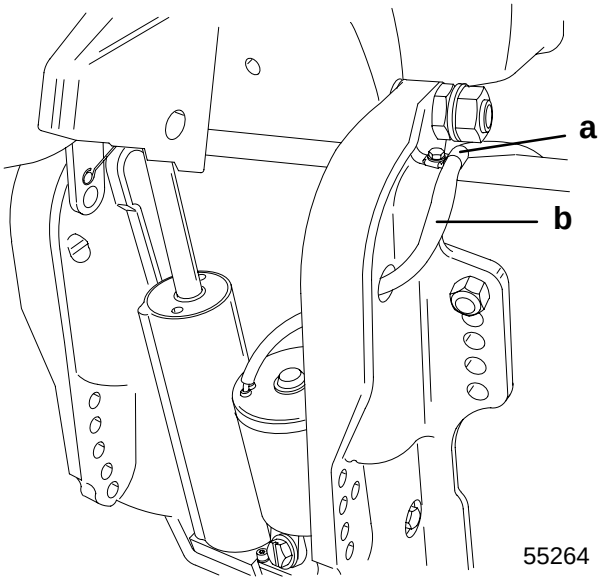
Power Trim System Removal

1. Tilt outboard to the full up position and support with tilt lock pin.



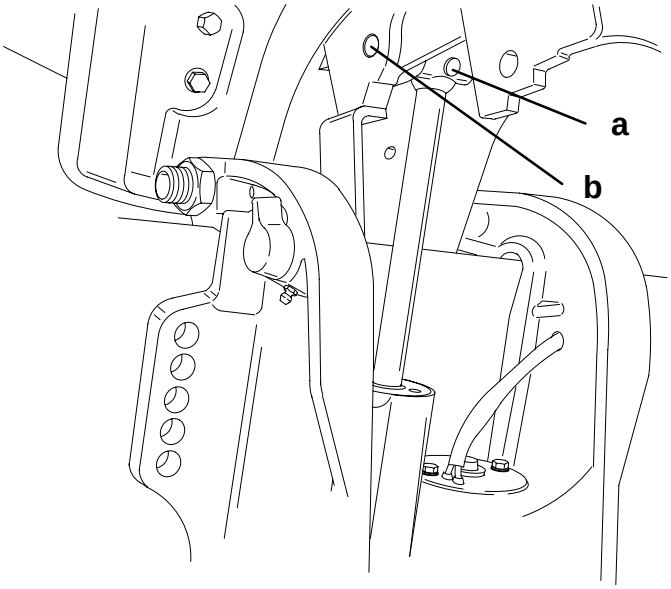
a - Tilt Lock Pin

2. Disconnect the power trim wire harness and remove clamp.



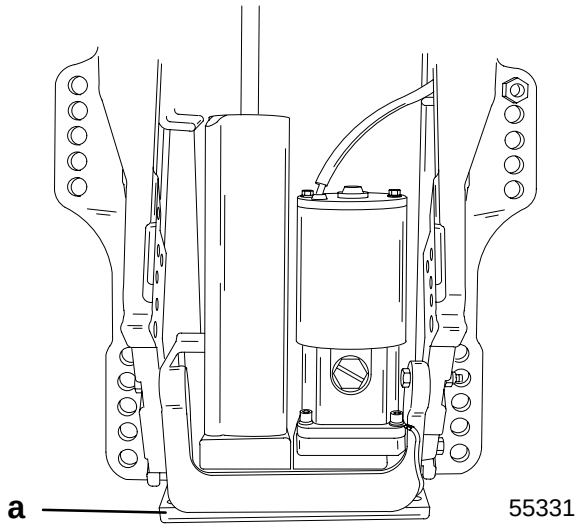
a - Power Trim Wire Harness Clamp
b - Harness

3. Remove the trilobe pin.
4. Drive out the upper pivot pin.



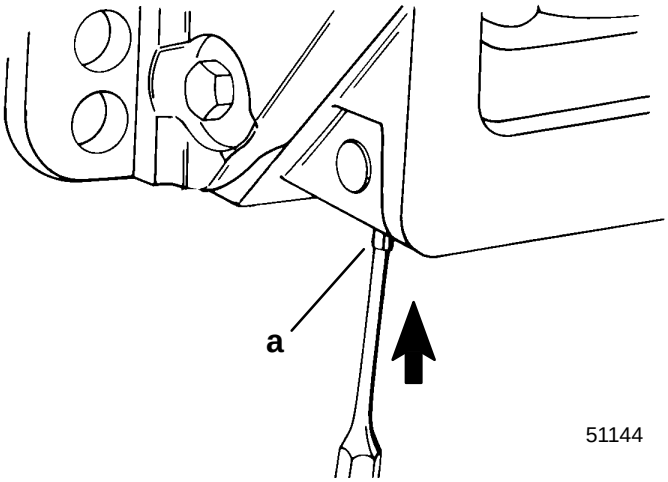
a - Trilobe Pin
b - Upper Pivot Pin

5. Remove the sacrificial anode.



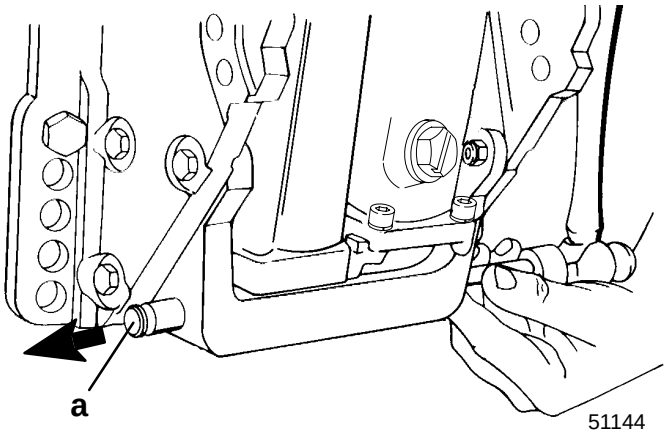
a - Sacrificial Anode

6. Use suitable punch to remove (Drive Up) lower pin. Retain dowel pin.



a - Dowel Pin

7. Use suitable punch to drive out lower pivot pin.

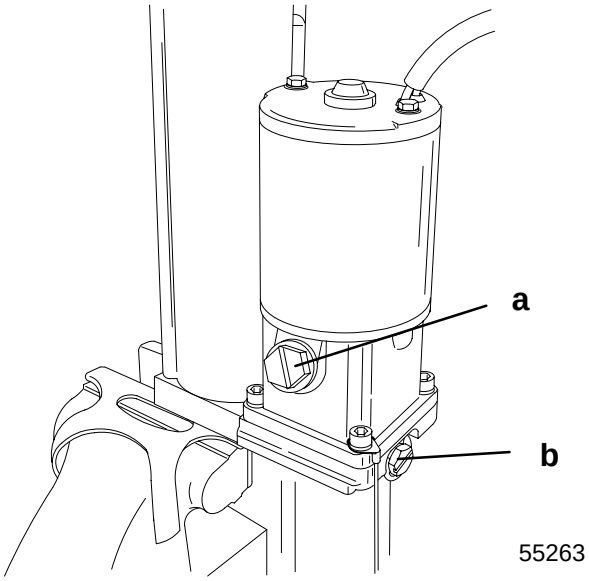


a - Lower Pivot Pin

Power Trim Disassembly

IMPORTANT: Power trim system is pressurized. Trim rod must be in the full "UP" position (fully extended) prior to fill/drain plug, or manual release valve removal.

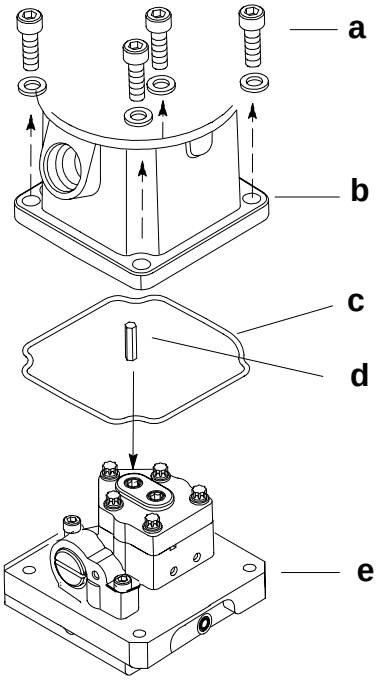
1. Remove reservoir cap.
2. Remove manual release valve assembly to drain oil.



a - Reservoir Cap
b - Manual Release Valve

Trim Motor Removal

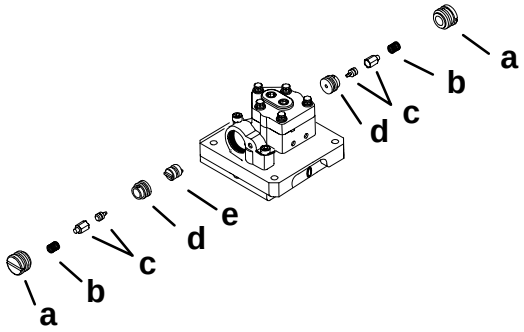
1. Secure power trim assembly in a soft jaw vise.
2. Remove four (4) screws to remove motor/reservoir. Remove reservoir seal and coupler.



a - Screw (4)
b - Reservoir
c - Reservoir Seal
d - Coupler
e - Manifold Assembly

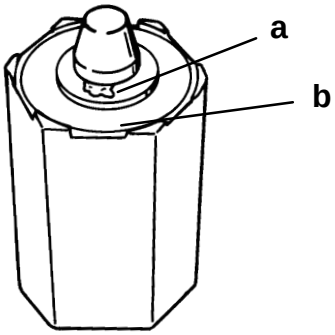
Pump and Components Removal

1. Remove pressure operated plugs on pump. Remove spring and check valve/poppet (both sides). Use special tool CG 41-11 and special tool CG 41-14 with 5/16″ end to remove spool.



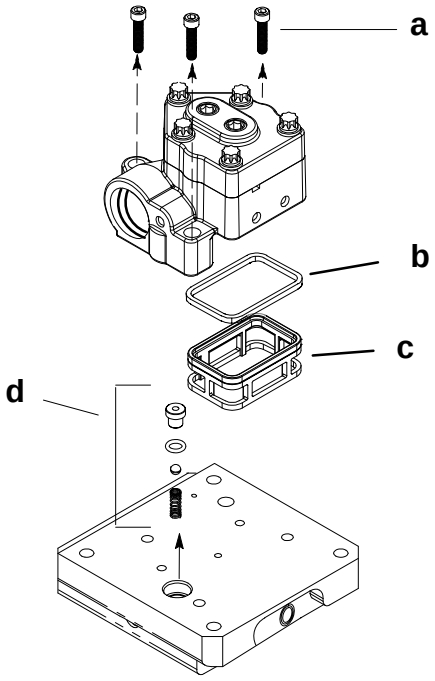
a - Plug (2)
b - Spring (2)
c - Check Valve/Poppet (2)
d - Seat (2)
e - Spool

IMPORTANT: Inspect poppet assembly for debris in the area shown. If debris is found on poppet, replace poppet.



a - Debris Under Valve Tip
b - Rubber Seat

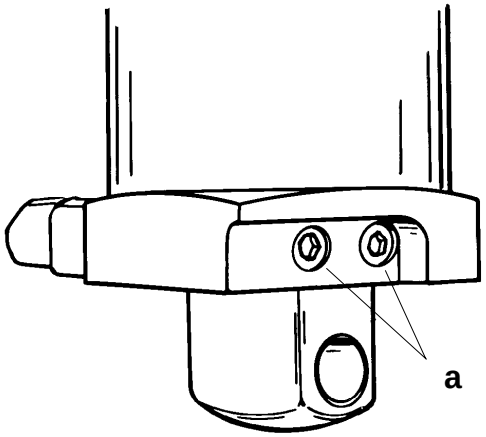
2. Remove three (3) screws to remove pump. Remove filter and filter seal under pump. Remove suction seat assembly.



a - Screws (3)
b - Filter Seal
c - Filter
d - Suction Seat Assembly

Manifold Removal

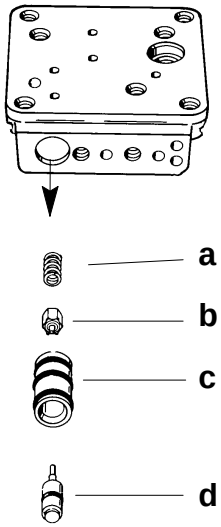
1. Remove two (2) screws to remove manifold from cylinder.



51146

a - Screw (2)

2. Remove tilt relief components.

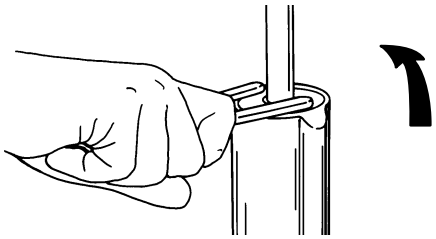


51008

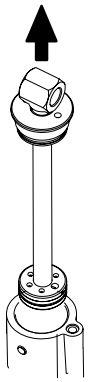
a - Spring
b - Poppet
c - Spool Housing
d - Trim Limit Spool

Shock Rod Removal

1. Unscrew end cap assembly from cylinder using spanner wrench [1/4 in. x 5/16 in. (6.4mm x 8mm) long pegs].

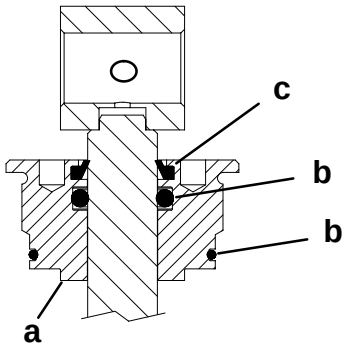


2. Remove shock rod assembly from cylinder.



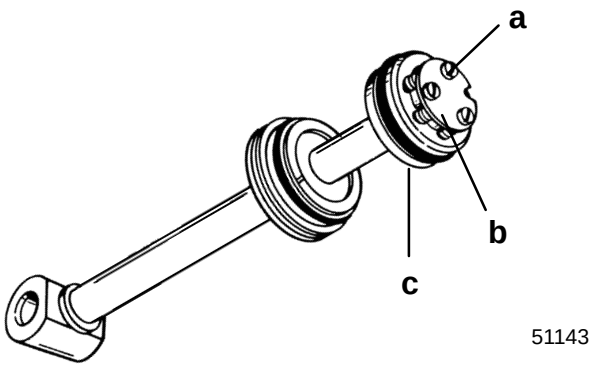
Shock Rod Disassembly

NOTE: *The only serviceable items on the shock rod assembly are the O-rings and wiper ring. If shock rod requires any other repair, replace shock rod assembly.*



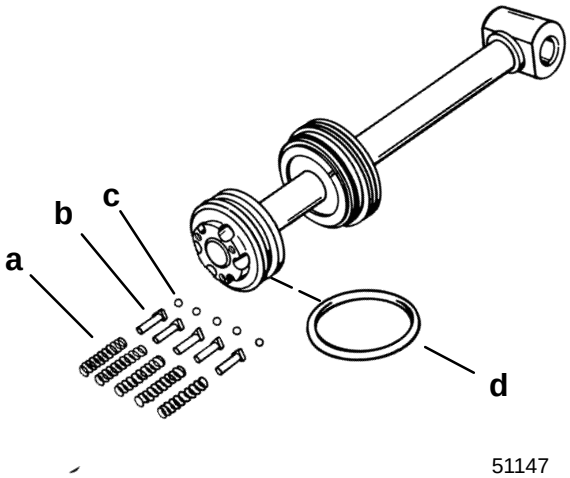
a - End Cap
b - O-ring
c - Wiper Ring

1. Place shock rod assembly on clean work surface.
2. Remove three (3) screws and remove plate from shock rod piston.



a - Screw (3)
b - Plate
c - Shock Rod Piston

3. Remove check ball components from shock rod piston.
4. Remove o-ring from shock rod piston.

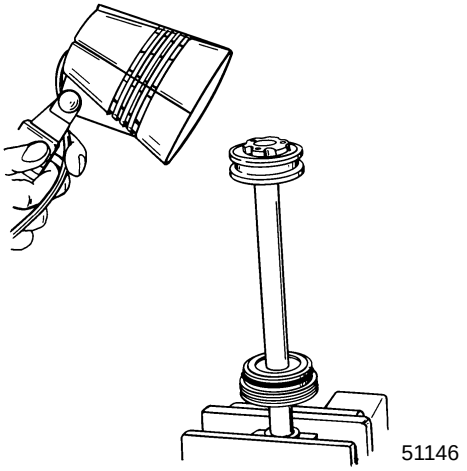


a - Spring (5)
b - Seat (5)
c - Ball (5)
d - O-ring

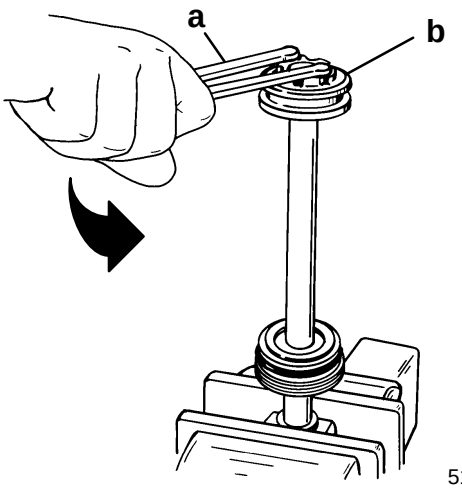
⚠ CAUTION

When removing shock piston, spanner wrench must have 1/4 in. x 5/16 in. long pegs to avoid damage to shock piston.

5. Place shock rod into soft jawed vise and apply heat to loosen piston using torch lamp (P/N 91-63209).
6. Loosen shock rod piston using spanner wrench [1/4 in. x 5/16 in. (6.4mm x 8mm) long pegs].
7. Allow shock rod piston to cool. Remove from shock rod.



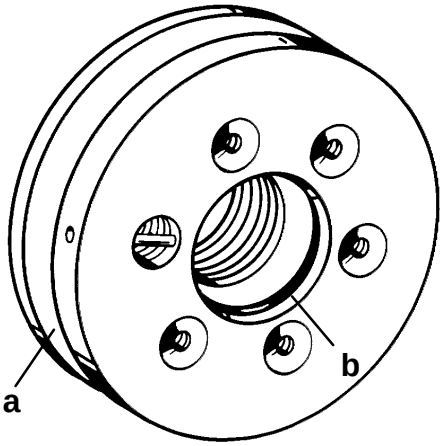
51146



51146

a - Spanner Wrench
b - Shock Rod Piston

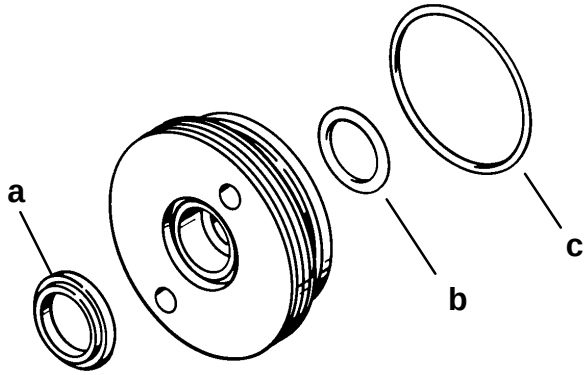
8. Inspect check valve for debris; clean debris from check valve if found. If debris cannot be cleaned from check valve, replace shock piston as an assembly.
9. Clean shock and components with compressed air.
10. Remove inner o-ring from shock rod piston.



51199

a - Shock Piston
b - O-ring

11. Remove cylinder end cap assembly from shock rod.
12. Inspect shock. If wiper (located in cap) has failed to keep rod clean, replace wiper.
13. Place end cap on clean work surface.
14. Remove rod wiper, inner o-ring, and outer o-ring.

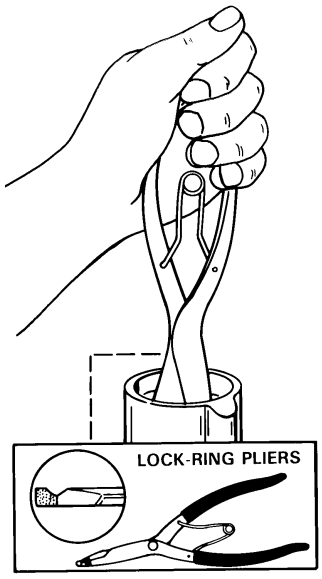


51145

a - Rod Wiper
b - Inner O-ring
c - Outer O-ring

Memory Piston Removal

1. Remove memory piston from cylinder using one of two methods:
   a. Using lock ring pliers (Craftsman P/N 4735) or suitable tool.



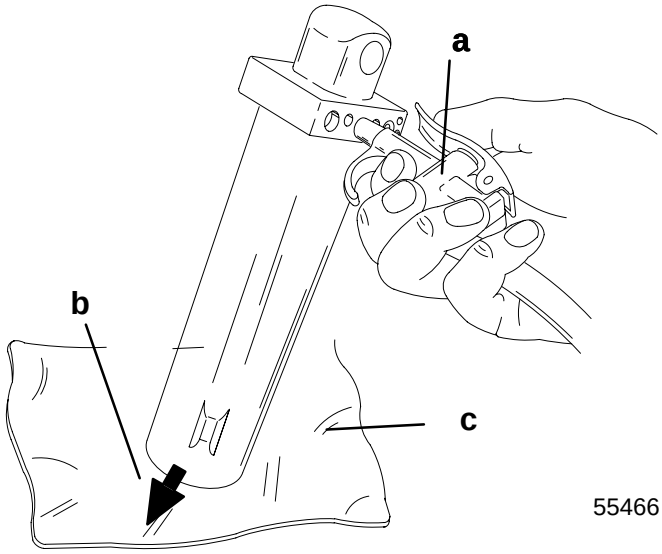
51144

   b. Blowing compressed air into manual release valve hole using adaptor (P/N 91-822778A3).

⚠ WARNING

Memory piston cup may be expelled at a high velocity when air pressure is applied. Failure to place cylinder as shown below could result in personal injury.

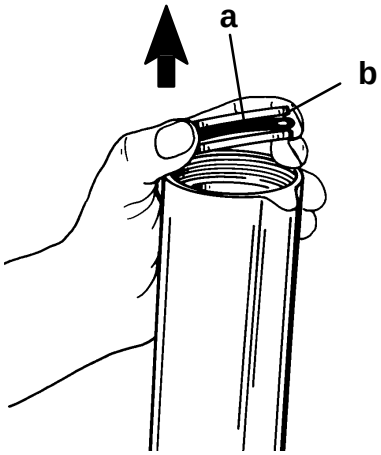
NOTE: *Point cylinder opening down and away. Use a shop rag or towel to avoid damage to the memory piston.*



55466

a - Adaptor/Air Hose
b - Memory Piston Exit
c - Shop Rag

2. Remove o-ring from memory piston.



51144

a - O-Ring
b - Memory Piston

Cleaning/Inspection/Repair

IMPORTANT: Components must be dirt and lint free. Slightest amount of debris in Power Trim system could cause system to malfunction.

Clean shock rod and components with parts cleaner and dry with compressed air.

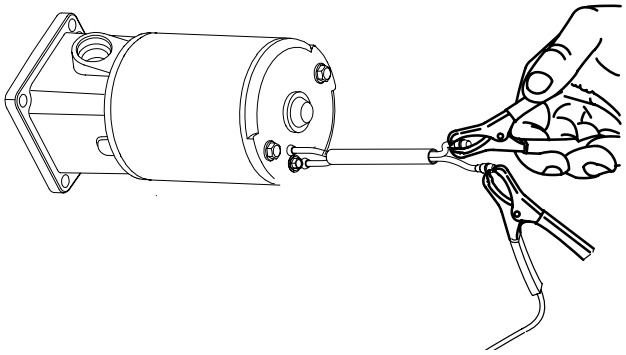
It is recommended that all O-rings in trim system be replaced. Use O-Ring Kit 25-827668A1.

Lubricate all o-rings with Quicksilver Power Trim Fluid (92-90100A12). If not available, use automotive (ATF) automatic transmission fluid.

Trim Motor Electrical Tests

1. Connect a 12 volt supply to motor leads. If motor fails to run, replace pump motor.

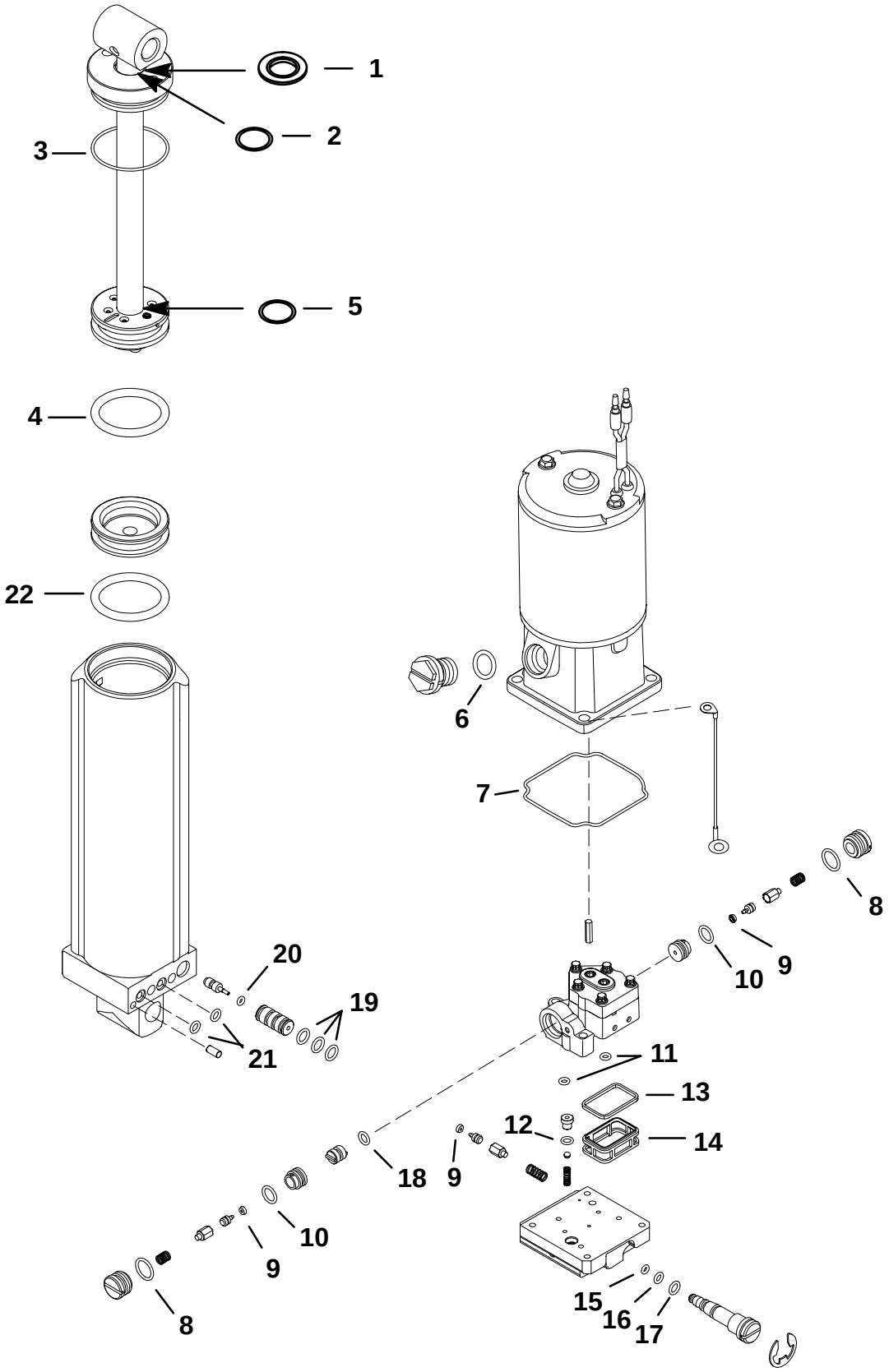
IMPORTANT: Trim Motor is not serviceable. If motor fails to run, replace motor assembly.



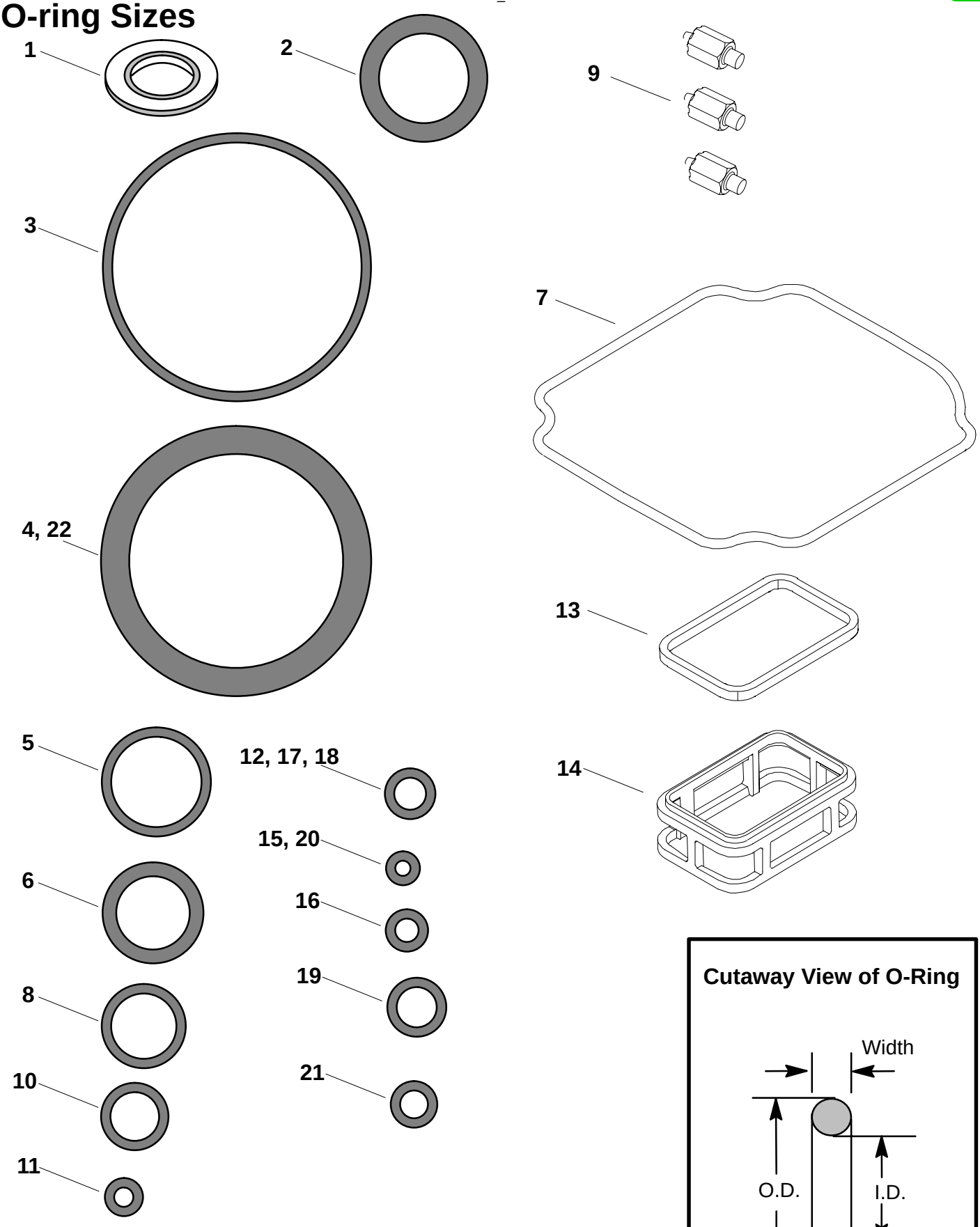
Reassembly

O-Ring and Seal Placement

O-Rings and Seals are part of O-Ring Kit 25-809880A1

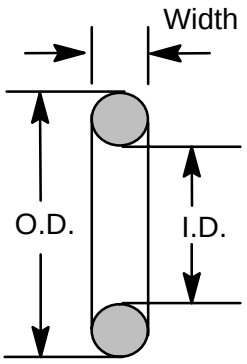


O-ring Sizes



O-RINGS SHOWN ARE ACTUAL SIZE

Cutaway View of O-Ring



O-ring Description and Sizes

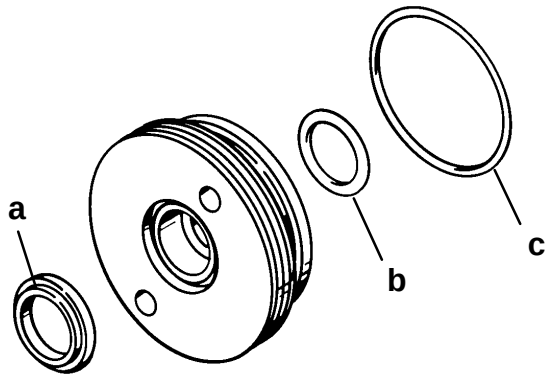
O-Ring	Description	O-Ring I.D.	O-Ring O.D.	O-Ring Width
1	Wiper Ring			
2	Cyl. Cap, Inner	0.671 in. (17.04 mm)	0.949 in. (24.10 mm)	0.139 in. (3.53 mm)
3	Cyl. Cap	1.864 in. (47.34 mm)	2.004 in. (50.90 mm)	0.07 in. (1.78 mm)
4	Shock Piston	1.6 in. (40.64 mm)	2.02 in. (53.086 mm)	0.21 in. (5.334 mm)
5	Piston Bolt	0.676 in. (17.17 mm)	.816 in. (20.726 mm)	0.07 in. (1.78 mm)
6	Reservoir Plug	0.549 in. (13.94 mm)	0.755 in. (19.17 mm)	0.103 in. (2.616 mm)
7	Motor Seal			
8 (2)	P.O. Check Plug	0.489 in. (12.42 mm)	0.629 in. (15.97 mm)	0.07 in. (1.78 mm)
9 (3)	Poppet Assy.			
10 (2)	P.O. Check Seat	0.364 in. (9.25 mm)	0.504 in. (12.80 mm)	0.07 in. (1.78 mm)
11 (2)	Pump Port	0.145 in. (3.683 mm)	0.285 in. (7.239 mm)	0.07 in. (1.78 mm)
12	Suction Seat	0.239 in. (6.07 mm)	0.379 in. (9.626 mm)	0.07 in. (1.78 mm)
13	Filter Seal			
14	Filter			
15	Manual Release	0.114 in. (2.90 mm)	0.254 in. (6.451 mm)	0.07 in. (1.78 mm)
16	Manual Release	0.176 in. (4.47 mm)	0.316 in. (8.026 mm)	0.07 in. (1.78 mm)
17	Manual Release	0.239 in. (6.07 mm)	0.379 in. (9.626 mm)	0.07 in. (1.78 mm)
18	Spool	0.239 in. (6.07 mm)	0.379 in. (9.626 mm)	0.07 in. (1.78 mm)
19 (3)	Spool Housing	0.301 in. (7.645 mm)	0.441 in. (11.20 mm)	0.07 in. (1.78 mm)
20	Trim Limit Spool	0.114 in. (2.895 mm)	0.254 in. (6.451 mm)	0.07 in. (1.78 mm)
21 (2)	Manifold	0.208 in. (5.283 mm)	0.348 in. (8.839 mm)	0.07 in. (1.78 mm)
22	Memory Piston	1.6 in. (40.64 mm)	2.02 in. (53.086 mm)	0.21 in. (5.334 mm)

Power Trim Reassembly

IMPORTANT: Lubricate all o-rings with Quicksilver Power Trim Fluid (92-90100A12). If not available, use automotive (ATF) automatic transmission fluid.

Shock Rod Reassembly

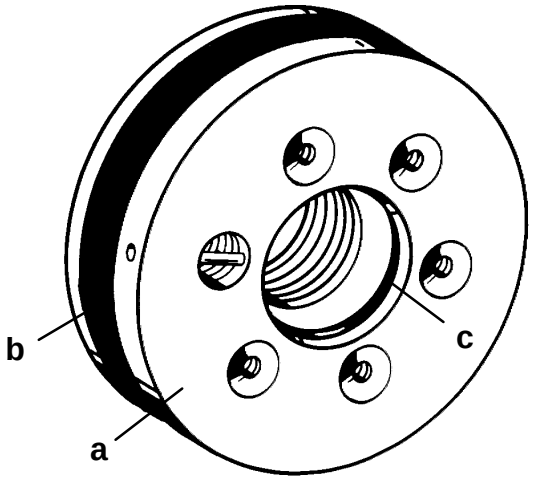
1. Install lubricated o-rings to end cap.
2. Install rod wiper.



51145

a - Rod Wiper
b - Inner O-ring
c - Outer O-ring

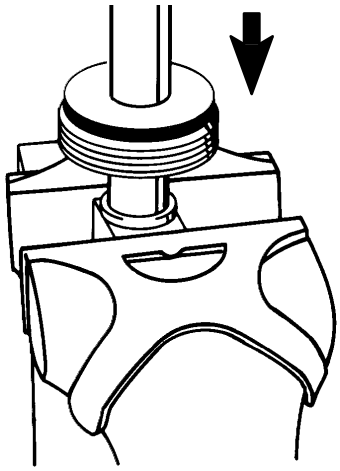
3. Install lubricated o-rings to shock piston.



51199

a - Shock Piston
b - O-ring
c - O-ring

4. Clamp shock rod in soft jawed vise.
5. Position cylinder end cap onto rod as shown.

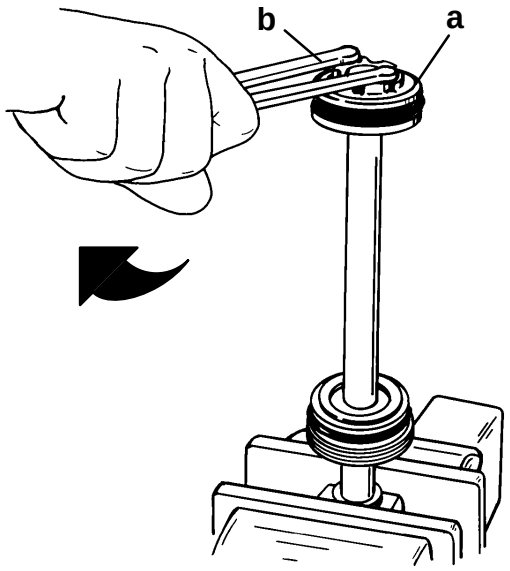


51146

⚠ CAUTION

When installing shock rod piston, spanner wrench must have1/4 in. x 5/16 in. (6.4mm x8mm) long pegs to avoid damage to shock rod piston.

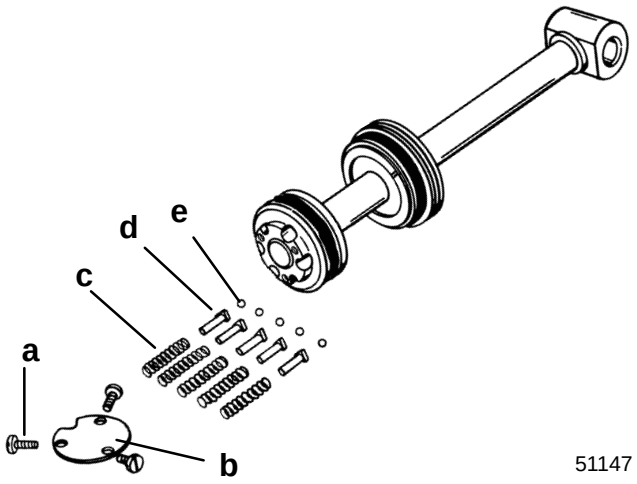
6. Apply Loctite Grade “A” (271) to threads on shock rod.
7. Install shock rod piston.
8. Tighten shock rod piston securely using spanner wrench (1/4 in. x 5/16 in. long pegs). If a torquing type spanner tool is used to tighten shock piston, then torque to 90 lb. ft. (122 N·m).



51146

a - Shock Rod Piston - Torque to 90 lb. ft. (122 N·m)
b - Spanner Wrench

9. Remove shock rod assembly from vise.
10. Install ball, seat, and spring (five sets) to shock rod piston.
11. Secure components with plate. Torque screws to 35 lb. in. (4.0 Nm).

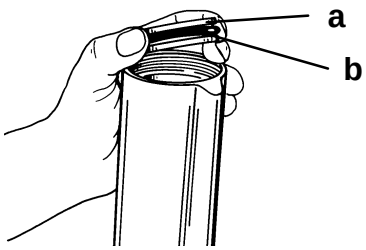


51147

a - Screws (3) Torque to 35 lb. in. (4.0 N·m)
b - Plate
c - Springs (5)
d - Seats (5)
e - Balls (5)

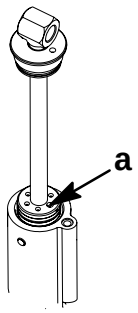
Shock Rod Installation

1. Place trim cylinder in soft jawed vice.
2. Install lubricated O-ring to memory piston and place into cylinder. Push memory piston all the way to bottom.



a - Memory Piston
b - O-ring

3. Fill cylinder three inches (76.2mm) from top of cylinder using Quicksilver Power Trim and Steering Fluid. If not available, use automotive (ATF) automatic transmission fluid.
4. Install shock rod into cylinder until power trim fluid flows through oil blow off ball passage. Fill remaining cylinder to just below the cylinder threads.

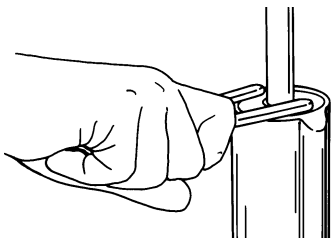


a - Oil Blow Off Ball Passage

⚠ CAUTION

End cap must not make contact with shock rod piston when tightening. Shock rod piston must be positioned in cylinder deep enough to avoid contact.

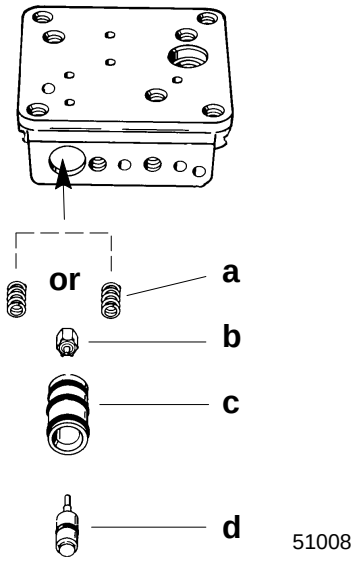
5. Tighten end cap securely using spanner wrench [1/4 in. x 5/16 in. (6.4mm x 8mm) long pegs].. If a torquing type spanner tool is used to tighten end cap, then torque to 45 lb. ft. (61.0 N·m).



Trim Limit Assembly Installation

1. Lubricate all O-rings. Install spring, poppet spool housing and trim limit spool into manifold.

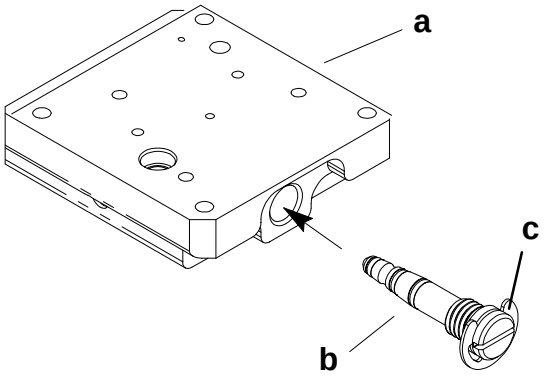
NOTE: *There are two different size springs used in this manifold. The heavy spring is used on 75 to 125 HP engines. The light spring is used on 40 to 60 HP engines.*



a - Spring
b - Poppet
c - Spool Housing
d - Trim Limit Spool

Manual Release Valve Installation

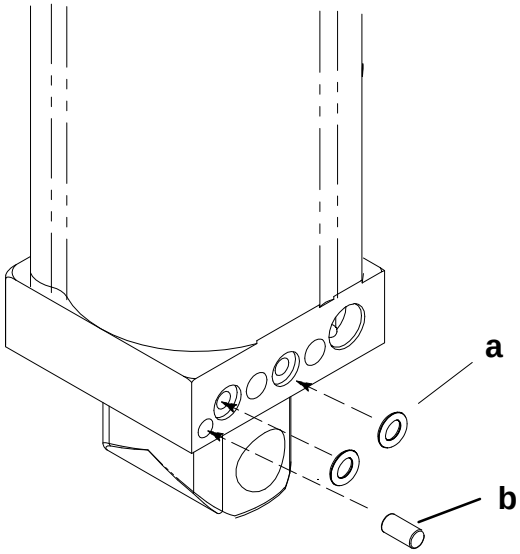
1. Install “E” clip (if removed) and lubricate O-rings to manual release valve.
2. Install manual release valve assembly into manifold.



a - Manifold
b - Manual Release Valve
c - E Clip

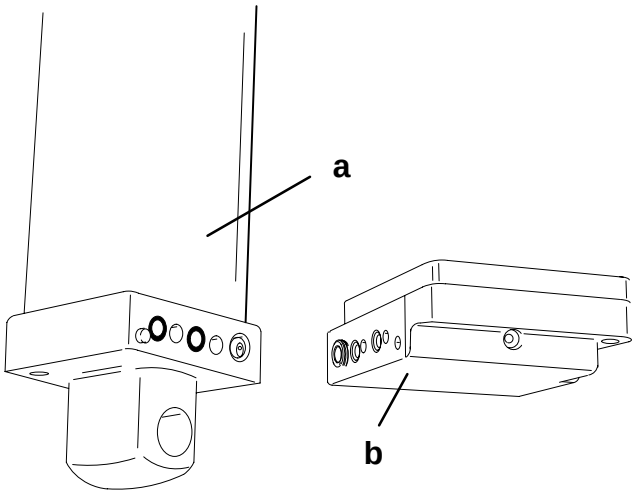
Manifold Installation

1. Install dowel pin and two (2) lubricated O-rings into trim cylinder.



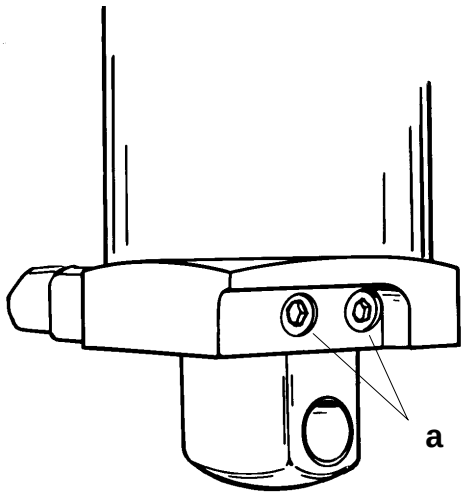
a - O-Rings (2)
b - Dowel Pin

2. Align the trim cylinder and pump/reservoir assembly together.



a - Trim Cylinder Assembly
b - Reservoir/Manifold Assembly

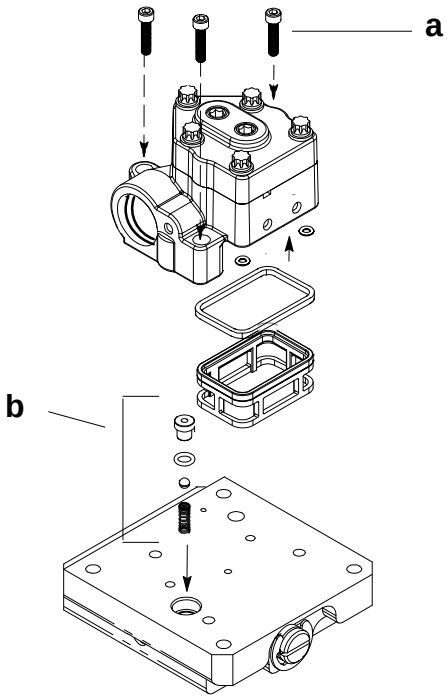
3. Install the two (2) long screws and torque to 100 lb. in. (11 N·m).



a - Screws (2) Torque to 100 lb. in. (11 N·m)

Oil Pump Installation

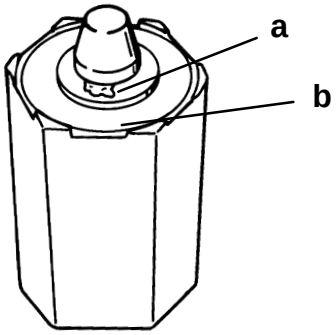
1. Install spring, ball, lubricated O-ring and plastic seat to manifold.
2. Check to see that O-rings are placed on bottom of pump.
3. Install filter and filter seal under pump. Install pump onto manifold. Torque screws to 70 lb. in. (7.7 N·m).



a - Screws (3) Torque to 70 lb. in. (7.7 N·m)
b - Suction Seat Assembly

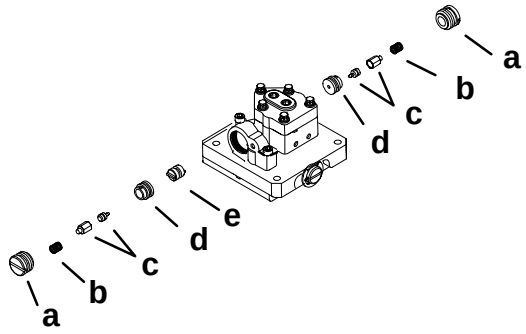
Pressure Operated Assembly Installation

IMPORTANT: Inspect poppet assembly for debris in the area shown. If debris is found on poppet replace poppet.



a - Debris Under Valve Tip
b - Rubber Seat

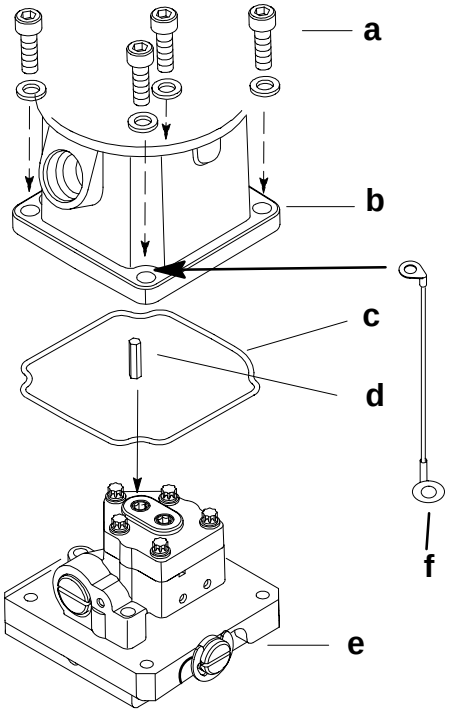
1. Lubricate o-rings.
2. Install spool, seat with O-ring, check valve/poppet, spring and plug with O-ring into pump. Repeat for other side. Torque plugs to 120 lb. in. (13.5 N·m).



a - Plugs (2) Torque to 120 lb. in. (13.5 N·m)
b - Springs (2)
c - Check Valve/Poppet (2)
d - Seats (2)
e - Spool

Reservoir/Motor Installation

3. Install coupler into top of pump. Make sure reservoir seal is in the reservoir groove and place reservoir onto pump/manifold assembly. Install ground strap under screw shown Torque screws to 80 lb. in. (9 N·m).

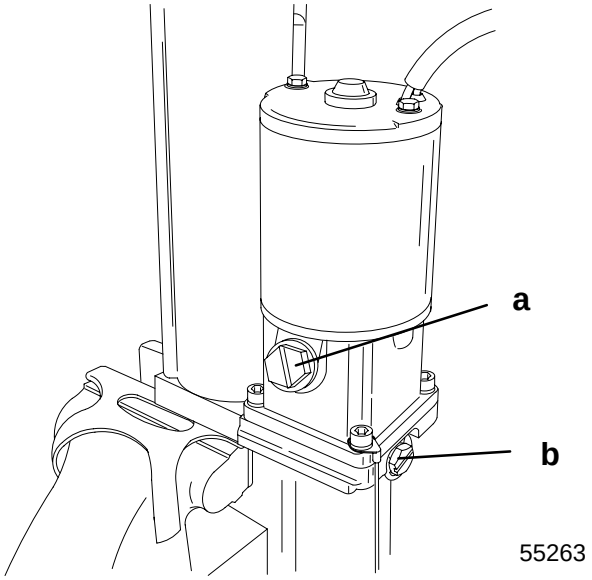


a - Screw (4) Torque to 80 lb. in. (9 N·m)
b - Reservoir
c - Reservoir Seal
d - Coupler
e - Manifold Assembly
f - Ground Strap

4. Fill reservoir to bottom of fill hole using Quicksilver Power Trim Fluid (92-901000A12). If not available, use automotive (ATF) automatic transmission fluid.

Bleeding Power Trim Unit

1. Secure power trim unit in soft jawed vise.
2. Add power trim fluid until even with the bottom of the fill hole. Reinstall plug.
3. Close the manual release valve. (Turn full clockwise).

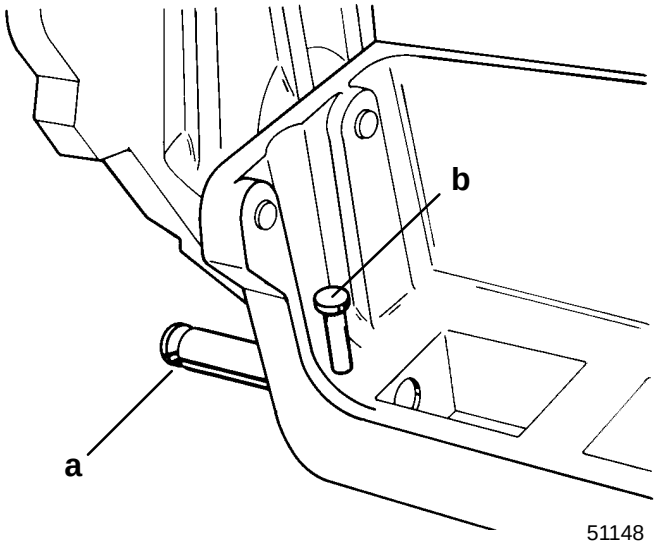


a - Reservoir Plug/Fill Hole
b - Manual Release Valve

4. Using a 12 volt power supply, connect the positive lead to (blue) trim motor wire and negative lead to (green) trim motor wire and drive shock rod to the up position. Repeat for three times.
5. Connect the positive lead to the (green) trim motor wire, and the negative lead to the (blue) trim motor wire and drive the shock rod to the down position.
6. Recheck fluid level, add fluid if required and repeat cycle until fluid level stays even with the bottom of the fill hole.

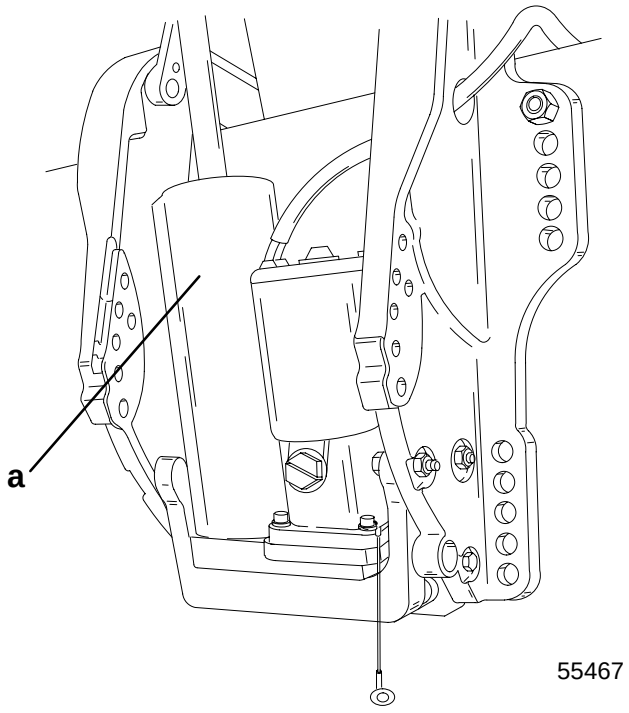
Installation of Power Trim System

1. Lubricate lower pivot pin, mounting holes with 2-4-C Marine Lubricant.
2. Start lower pivot pin into pivot pin bore and position lower dowel pin (Retained) in its respective hole.



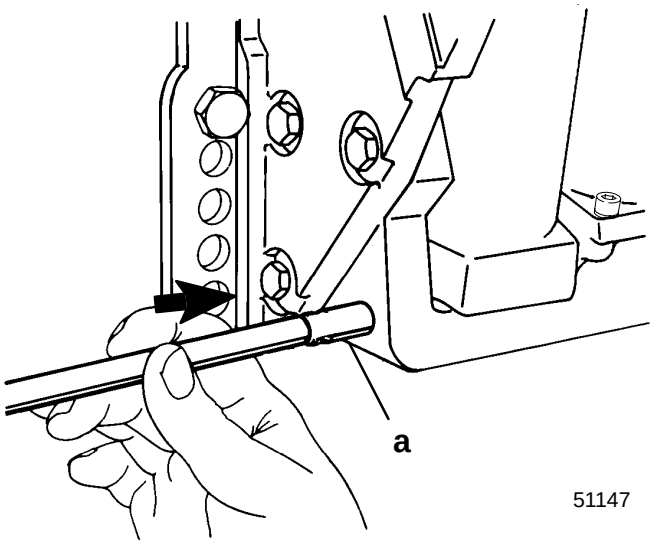
a - Lower Pivot Pin
b - Lower Dowel Pin

3. Position trim cylinder assembly (Bottom First) between clamp brackets.



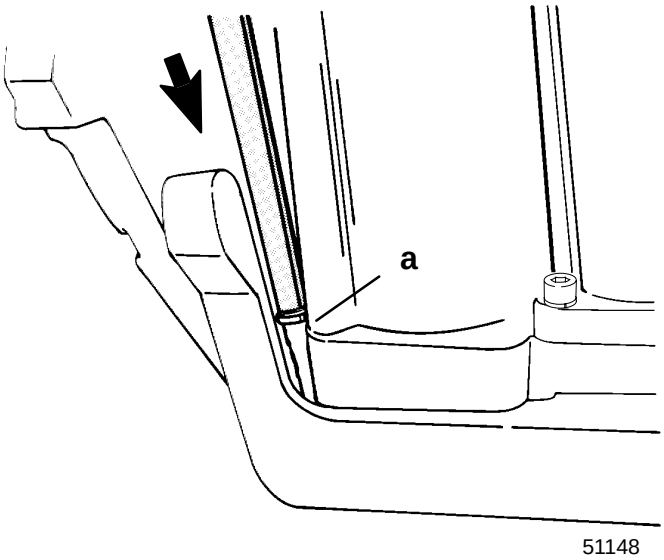
a - Trim Cylinder Assembly

4. Apply 2-4-C Marine Lubricant (92-90018A12) to lower pivot pin. Using a suitable punch, drive lower pivot pin into clamp bracket and trim cylinder assembly until pivot pin is flush with outside surface.



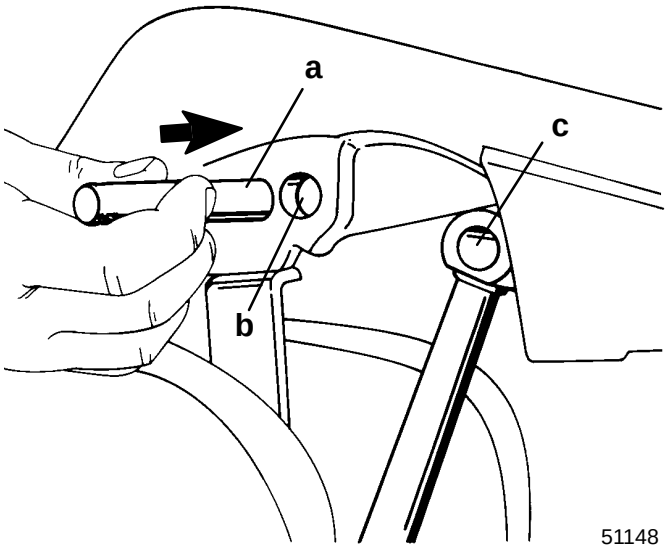
a - Lower Pivot Pin

5. Using a suitable punch, drive lower dowel pin into its hole until seated.



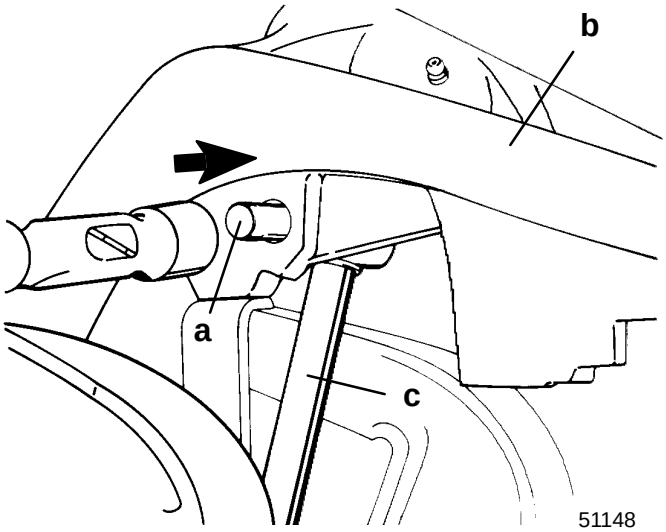
a - Lower Dowel Pin

6. Apply 2-4-C Marine Lubricant (92-90018A12) to surface of upper pivot pin, pivot pin bore and trim ram bore.



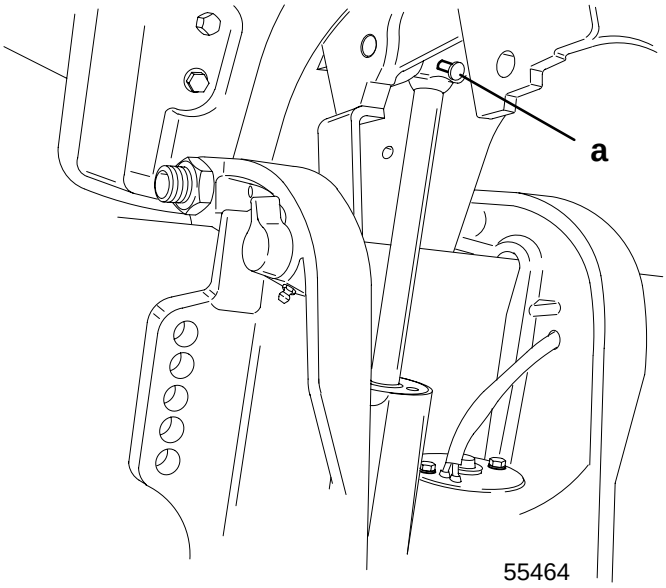
a - Pivot Pin
b - Pivot Pin Bore
c - Trim Ram Bore

7. Using a suitable mallet, drive upper pivot pin into swivel bracket and through trim ram until pivot pin is flush with swivel bracket.



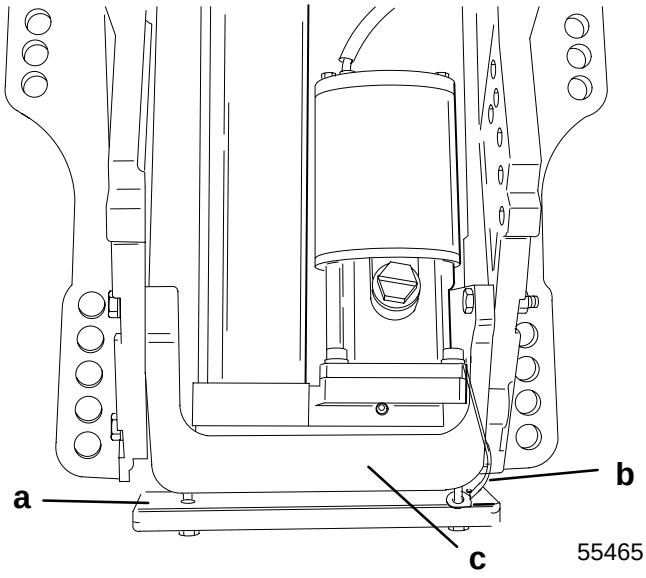
a - Pivot Pin
b - Swivel Bracket
c - Trim Ram

8. Drive trilobe pin (a) into its hole until seated.



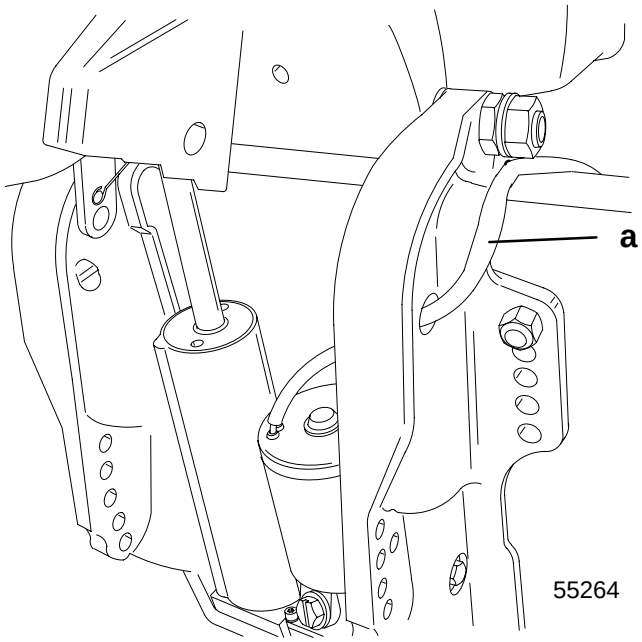
a - Trilobe Pin

9. Install sacrificial aluminum anode to reservoir bracket placing ground strap between bracket and anode as shown.



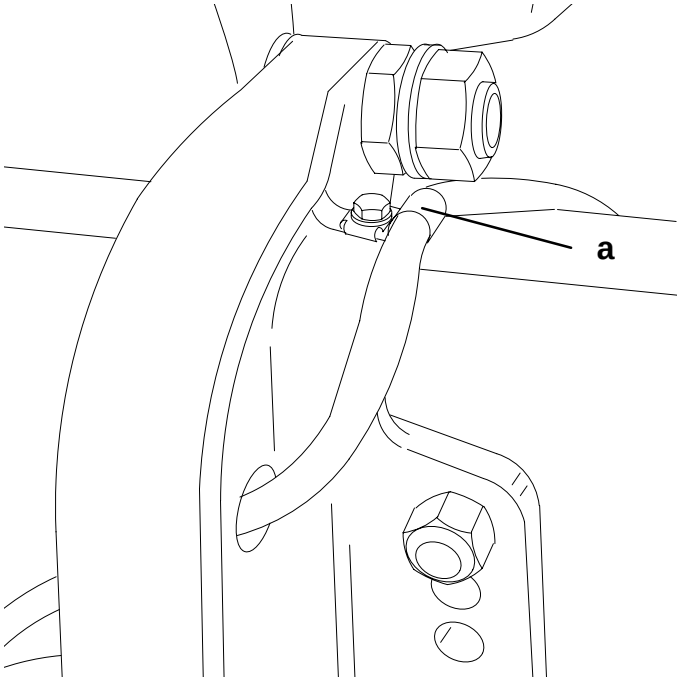
a - Sacrificial Anode
b - Ground Strap
c - Bracket

10. Route trim harness through clamp bracket and cowling.



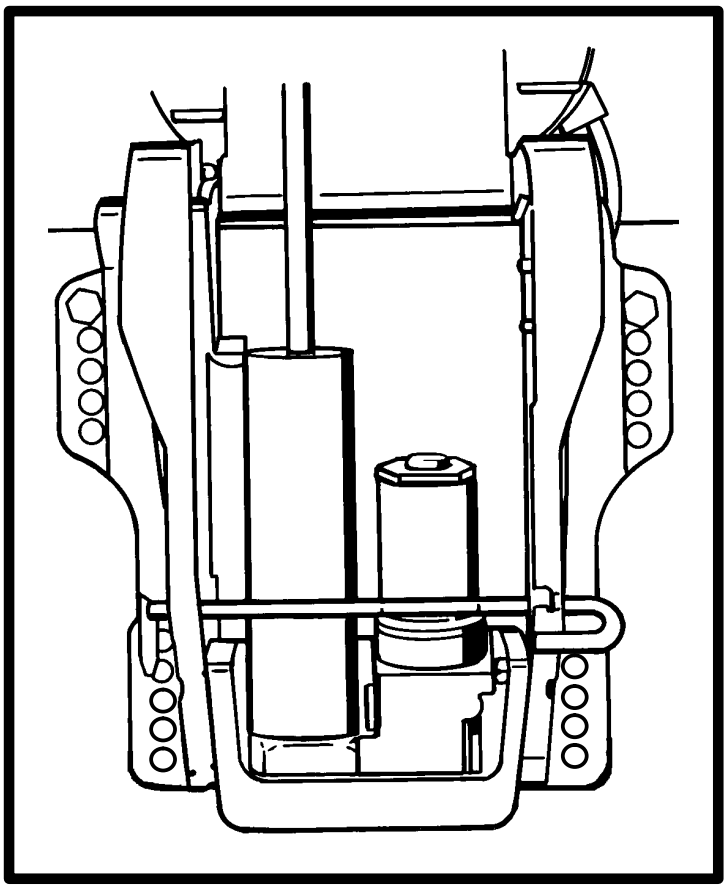
a - Trim Harness

11. Secure trim harness with clamp as shown.



a - Clamp

MID-SECTION



MANUAL TILT SYSTEM (DESIGN I, II, III)

5

F

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Manual Tilt System Components (Design One and Two)

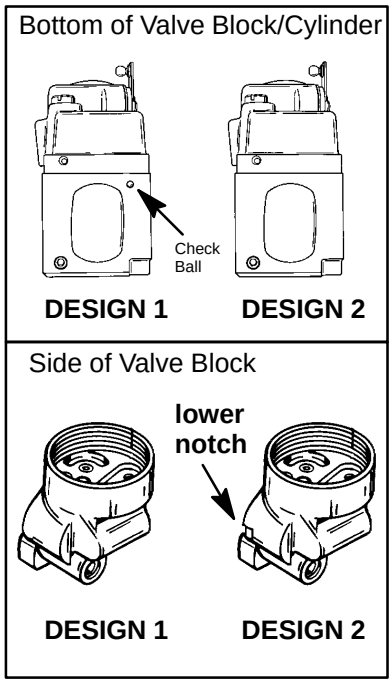
1 - Shock Rod Cylinder
2 - Accumulator
3 - Shock Rod
4 - Valve Block
5 - Dowel Pin
6 - Pivot Pin
7 - Rod Wiper
8 - O-ring .671 in. I.D.
9 - Cylinder Cap
10- O-ring 1.864 in I.D
11- O-ring .614 in. I.D.
12- Shock Rod Piston
13- Ball (5)
14- Spring Seat (5)
15- Spring (5)
16- Retaining Plate
17- Screw (3)
18- O-ring 1.600 in. I.D. (Shock Piston)
19- O-ring 1.600 in. I.D. (Memory Piston)
20- Memory Piston
21- Screw (2)
22- O-Ring .208 in. I.D. (2)
23- Pipe Plug
24- Spring (Large)
25- Spring (Small)
26- Ball
27- Plunger
28- Screw Plug (2)
29- Spring (2)
30- O-ring (2)
31- Ball (2)
32- Push Rod (2)
33- Dowel Pin
34- Spool
35- Spring
36- O-ring .301 in I.D.
37- Screw Plug
38- O-ring .301 in. I.D.
39- Cam Shaft
40- Insulator
41- Retainer Plate
42- Screw
43- O-ring 2.114 in. I.D.
44- Push Rod
45- Ball
46- Flat Spring
47- Screw

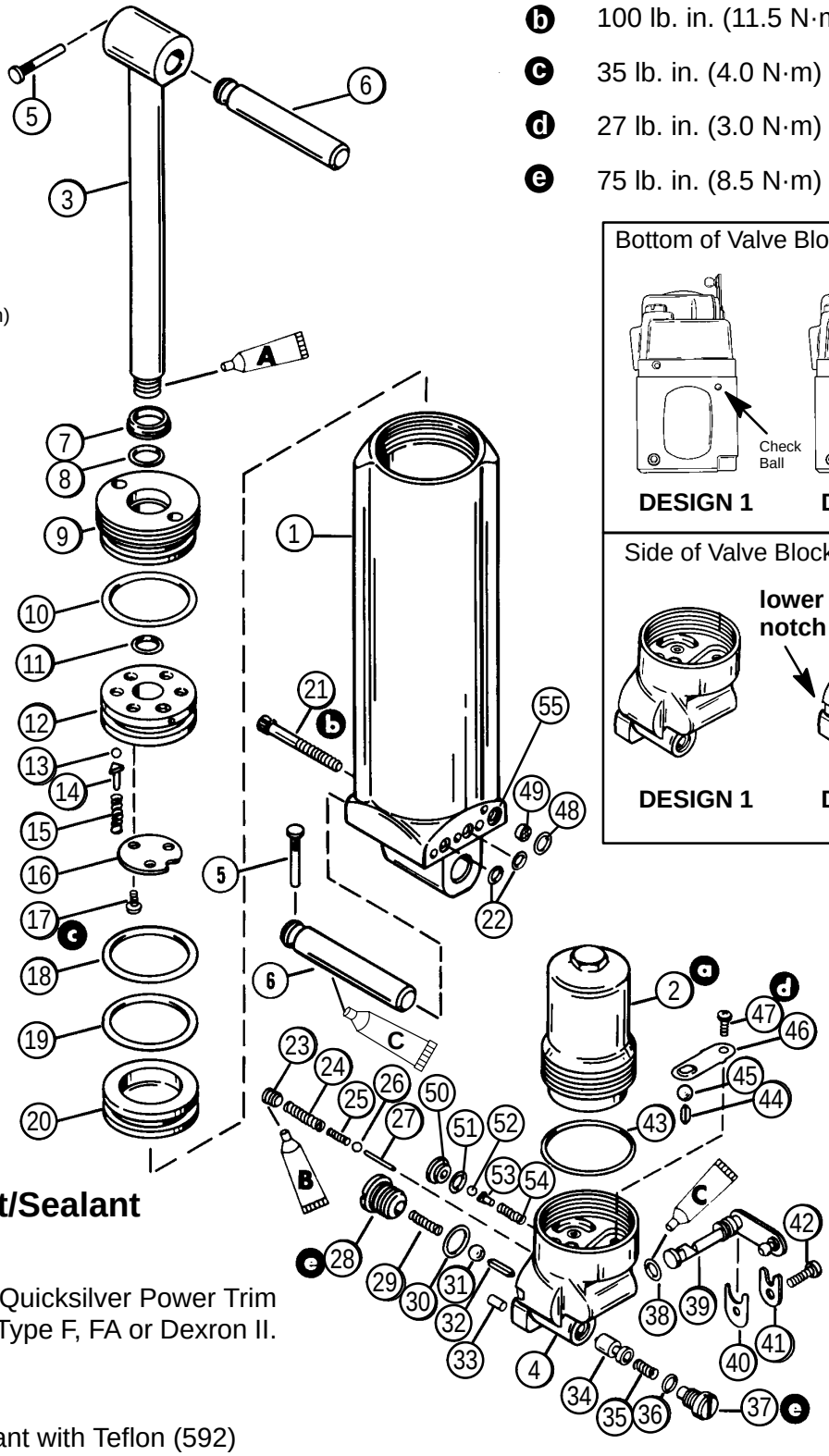
Design One Only

48- O-ring
49- Filter
50- Valve Seat
51- O-ring .364 in. I.D.
52- Ball
53- Spring Guide
54- Spring
55- Hole in Cyliner

Torque Specification

- (a) 35 lb. ft. (47 N·m)
- (b) 100 lb. in. (11.5 N·m)
- (c) 35 lb. in. (4.0 N·m)
- (d) 27 lb. in. (3.0 N·m)
- (e) 75 lb. in. (8.5 N·m)





26153

Quicksilver Lubricant/Sealant Application Points

Lubricate ALL O-rings using Quicksilver Power Trim and Steering Fluid or; (ATF) Type F, FA or Dexron II.

- A — Loctite 271
- B — Loctite Pipe Sealant with Teflon (592)
- C — Special Lubricant 101

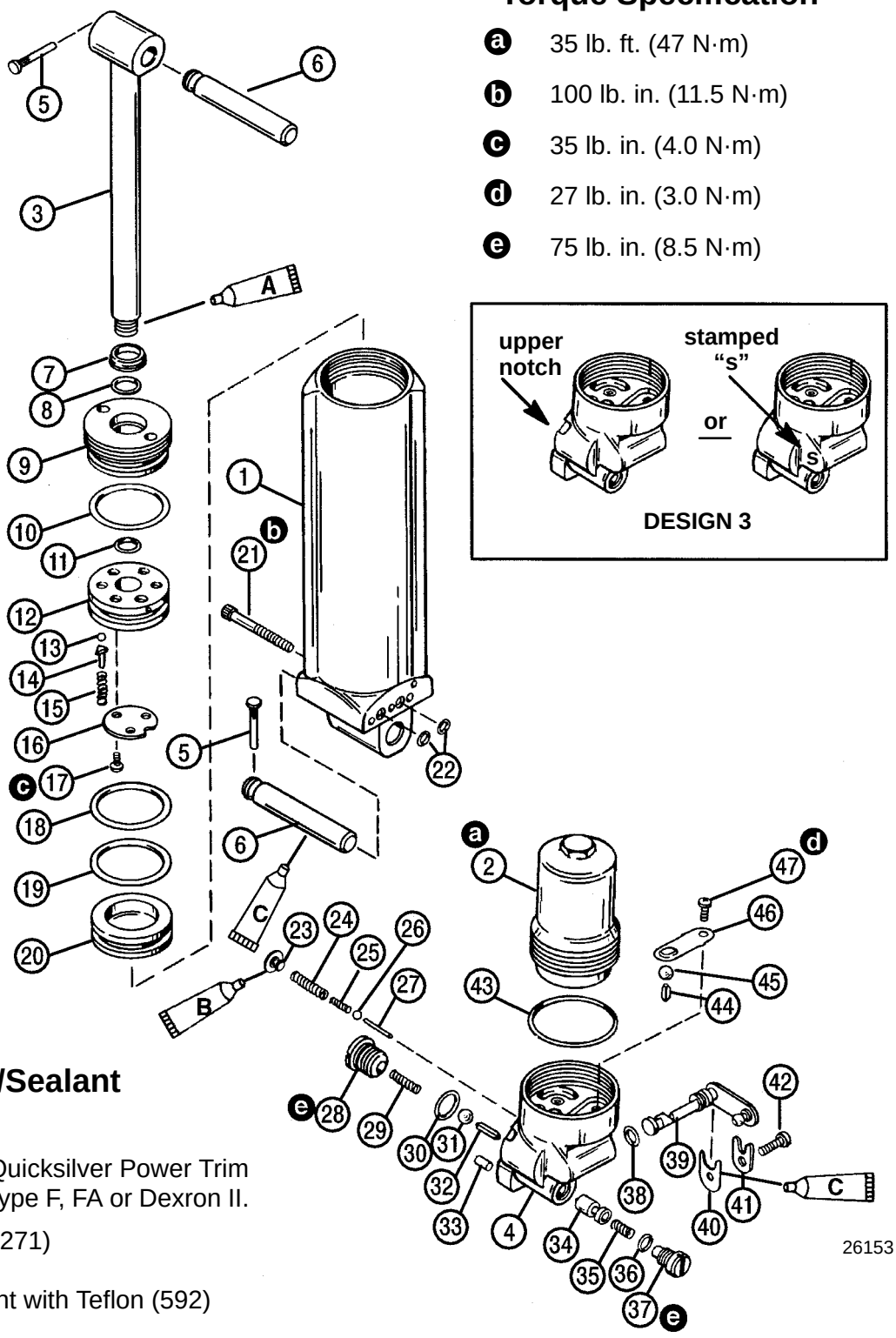
NOTE: *It is recommended that* ***ALL*** *O-rings be replaced when servicing tilt system.*

Manual Tilt System Components (Design Three)

1 - Shock Rod Cylinder
2 - Accumulator
3 - Shock Rod
4 - Valve Block
5 - Dowel Pin
6 - Pivot Pin
7 - Rod Wiper
8 - O-ring .671 in. I.D.
9 - Cylinder Cap
10- O-ring 1.864 in I.D
11- O-ring .614 in. I.D.
12- Shock Rod Piston
13- Ball (5)
14- Spring Seat (5)
15- Spring (5)
16- Retaining Plate
17- Screw (3)
18- O-ring 1.600 in. I.D. (Shock Piston)
19- O-ring 1.600 in. I.D. (Memory Piston)
20- Memory Piston
21- Screw (2)
22- O-Ring .208 in. I.D. (2)
23- Plug
24- Spring (Large)
25- Spring (Small)
26- Ball
27- Plunger
28- Screw Plug (2)
29- Spring (2)
30- O-ring (2)
31- Ball (2)
32- Push Rod (2)
33- Dowel Pin
34- Spool
35- Spring
36- O-ring .301 in I.D.
37- Screw Plug
38- O-ring .301 in. I.D.
39- Cam Shaft
40- Insulator
41- Retainer Plate
42- Screw
43- O-ring 2.114 in. I.D.
44- Push Rod
45- Ball
46- Flat Spring
47- Screw

Torque Specification

- (a) 35 lb. ft. (47 N·m)
- (b) 100 lb. in. (11.5 N·m)
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- (e) 75 lb. in. (8.5 N·m)



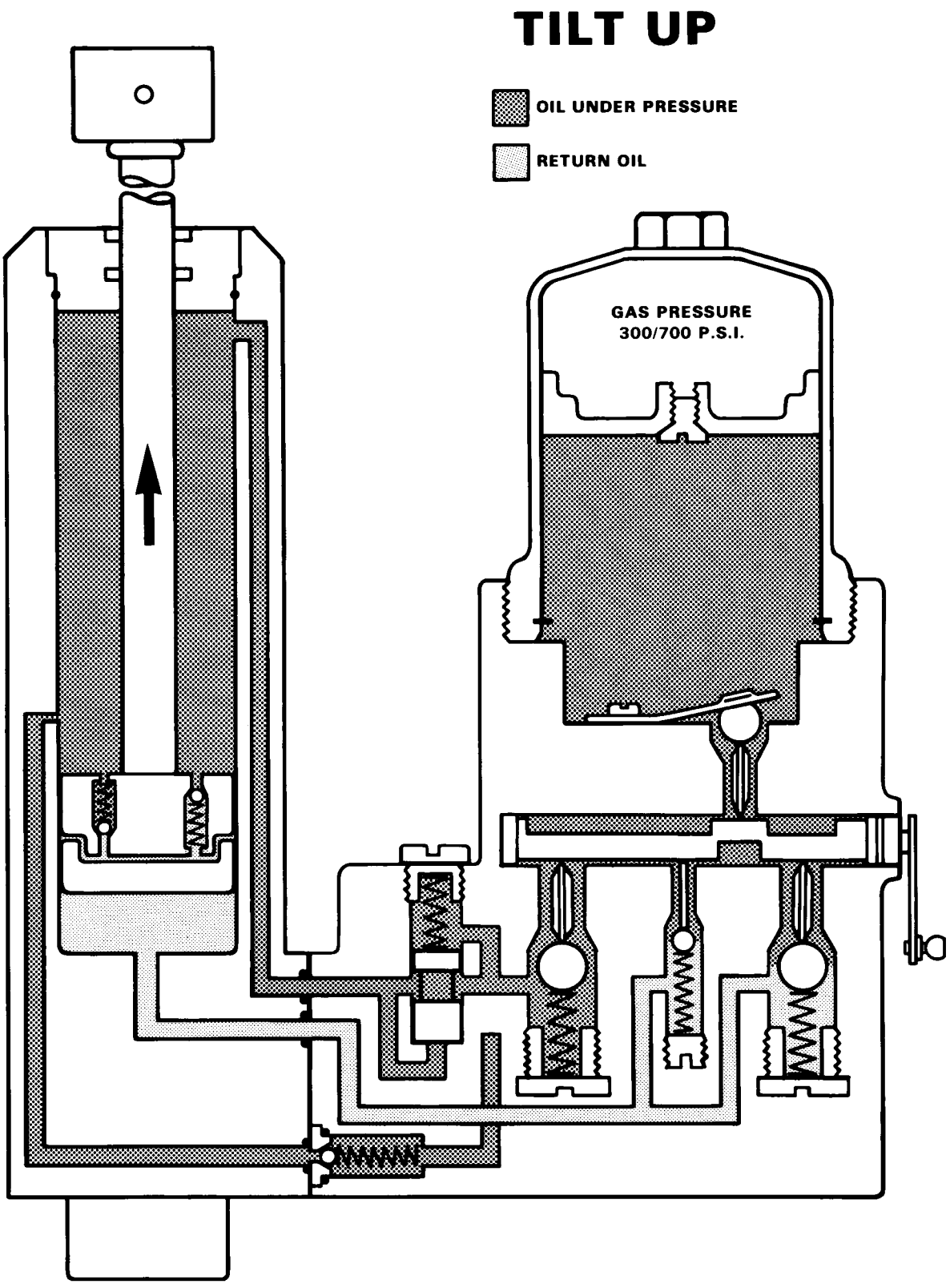
Quicksilver Lubricant/Sealant Application Points

Lubricate ALL O-rings using Quicksilver Power Trim and Steering Fluid or; (ATF) Type F, FA or Dexron II.

- A — Loctite Grade “A” (271)
- B — Loctite Pipe Sealant with Teflon (592)
- C — Special Lubricant 101

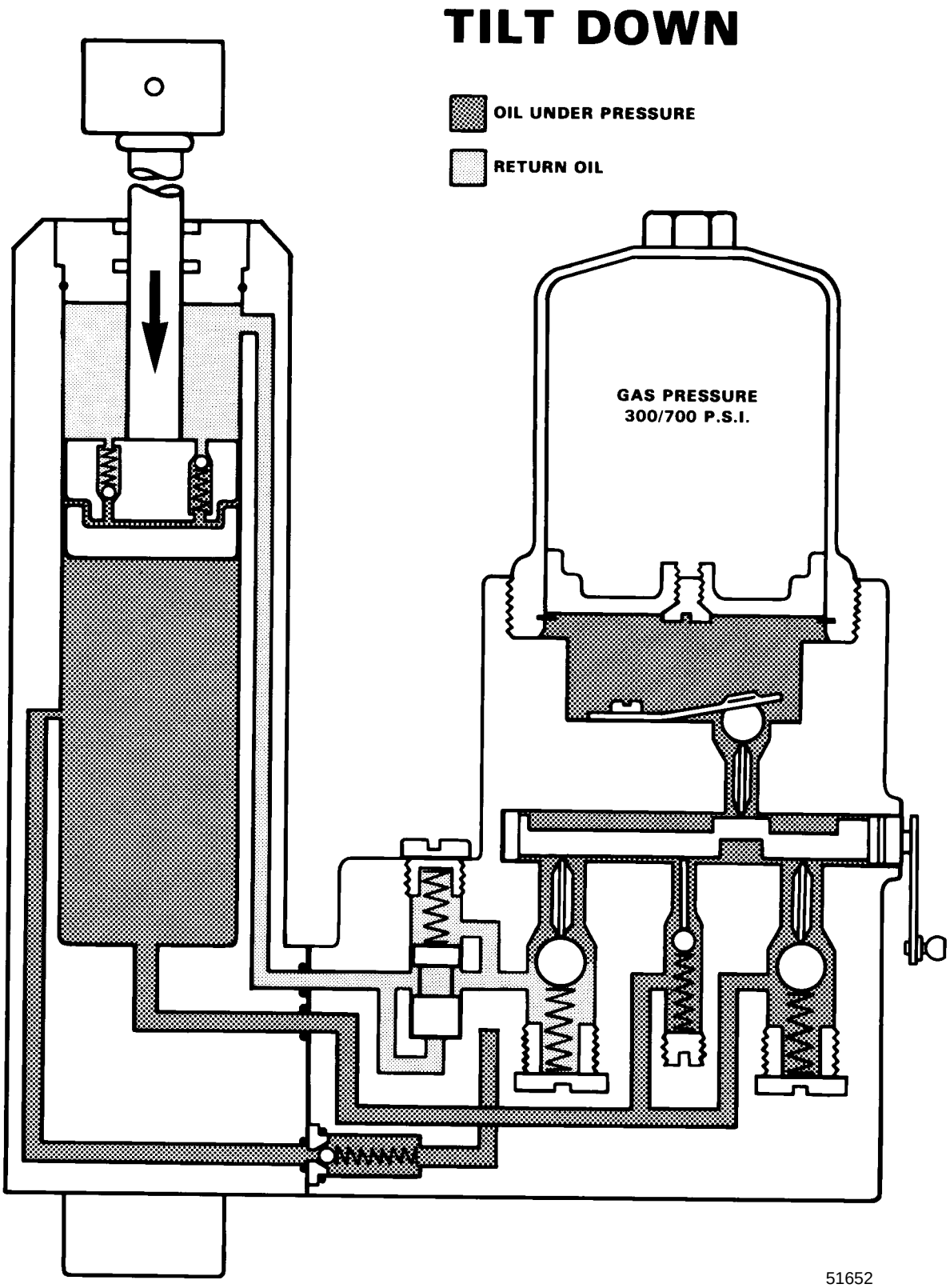
NOTE: *It is recommended that* ***ALL*** *O-rings be replaced when servicing tilt system.*

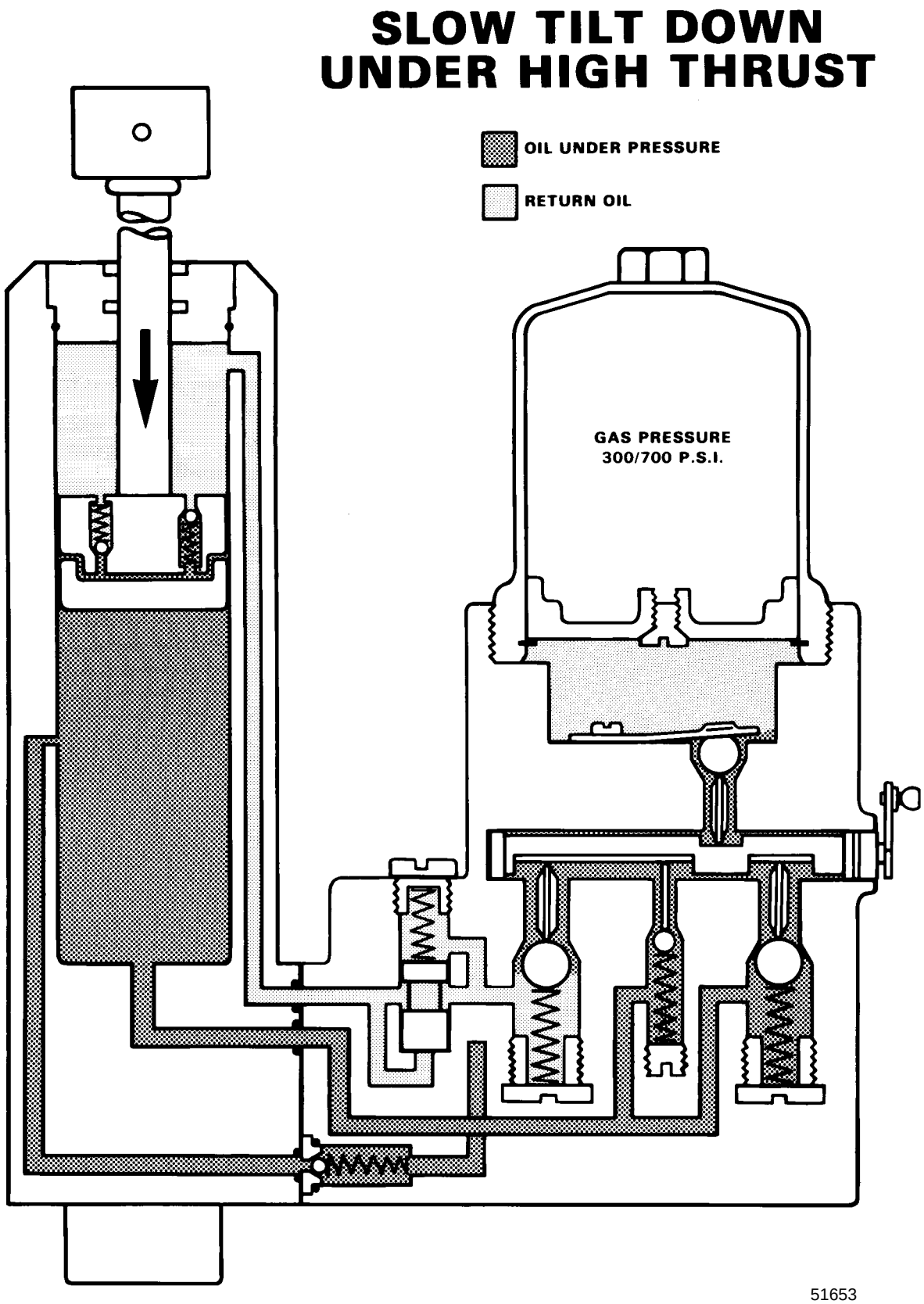
Manual Tilt Flow Diagrams
Design 1



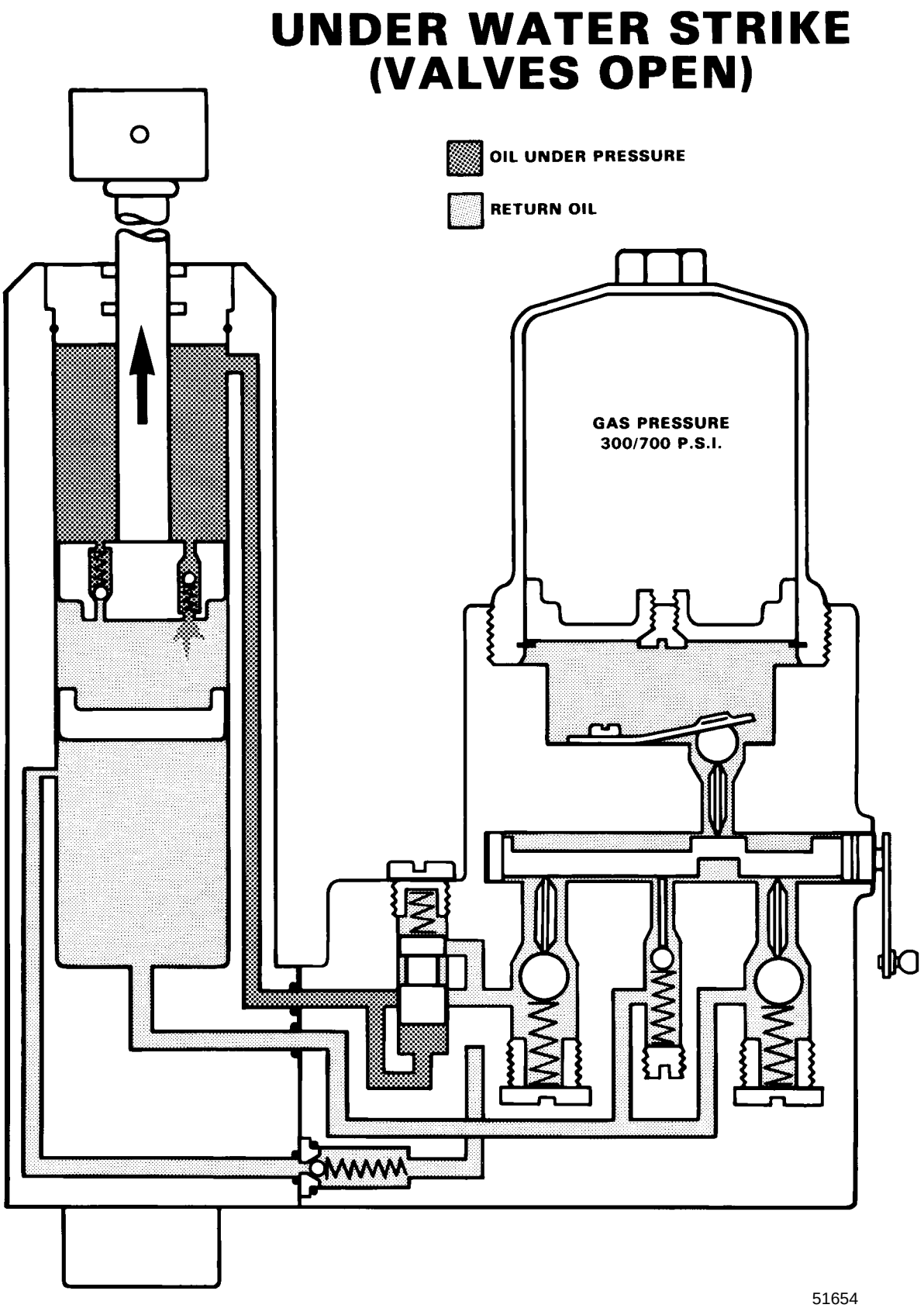
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Design 1

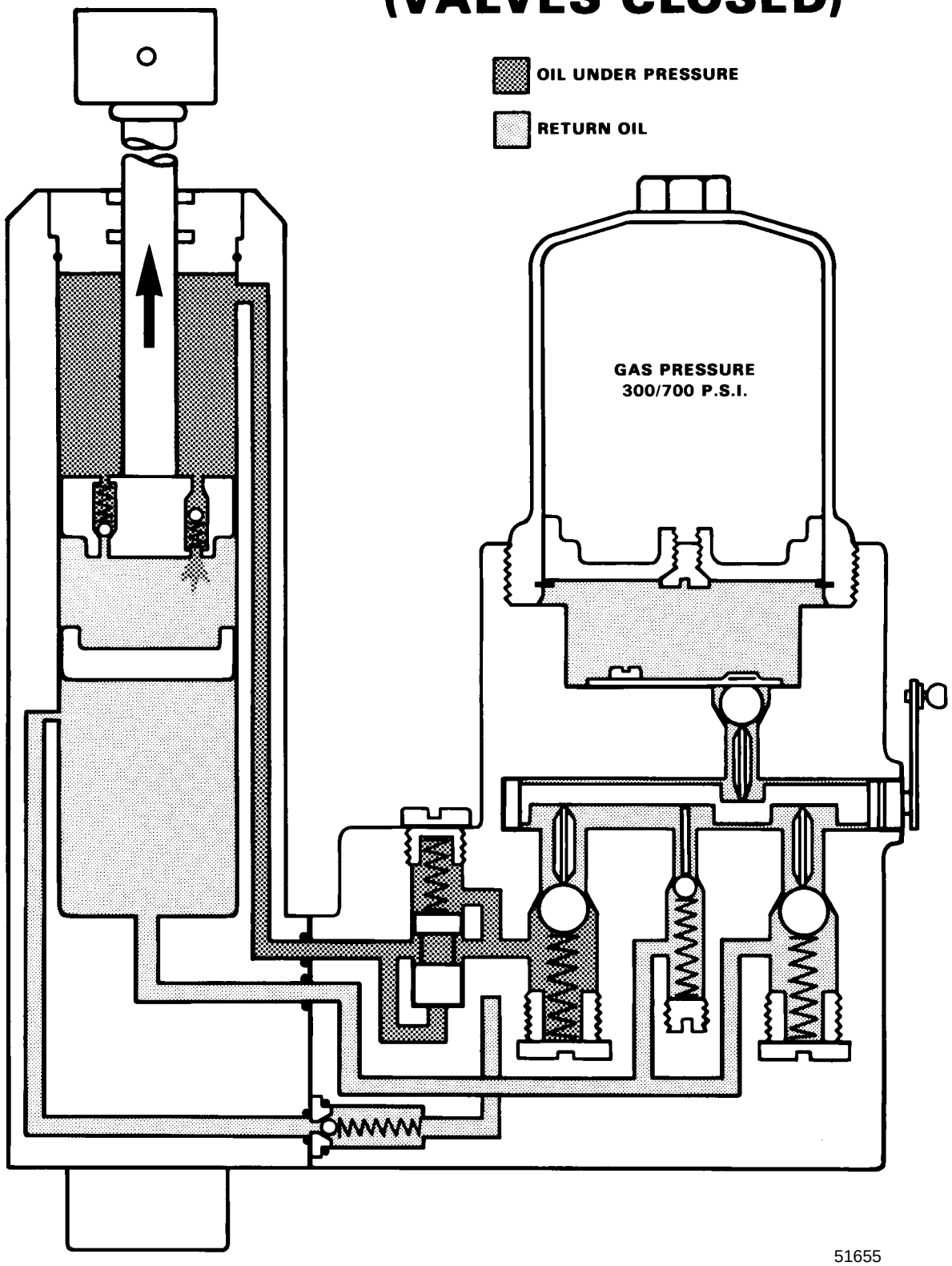

TILT DOWN
OIL UNDER PRESSURE
RETURN OIL
GAS PRESSURE
300/700 P.S.I.
51652


SLOW TILT DOWN
UNDER HIGH THRUST
OIL UNDER PRESSURE
RETURN OIL
GAS PRESSURE
300/700 P.S.I.
51653

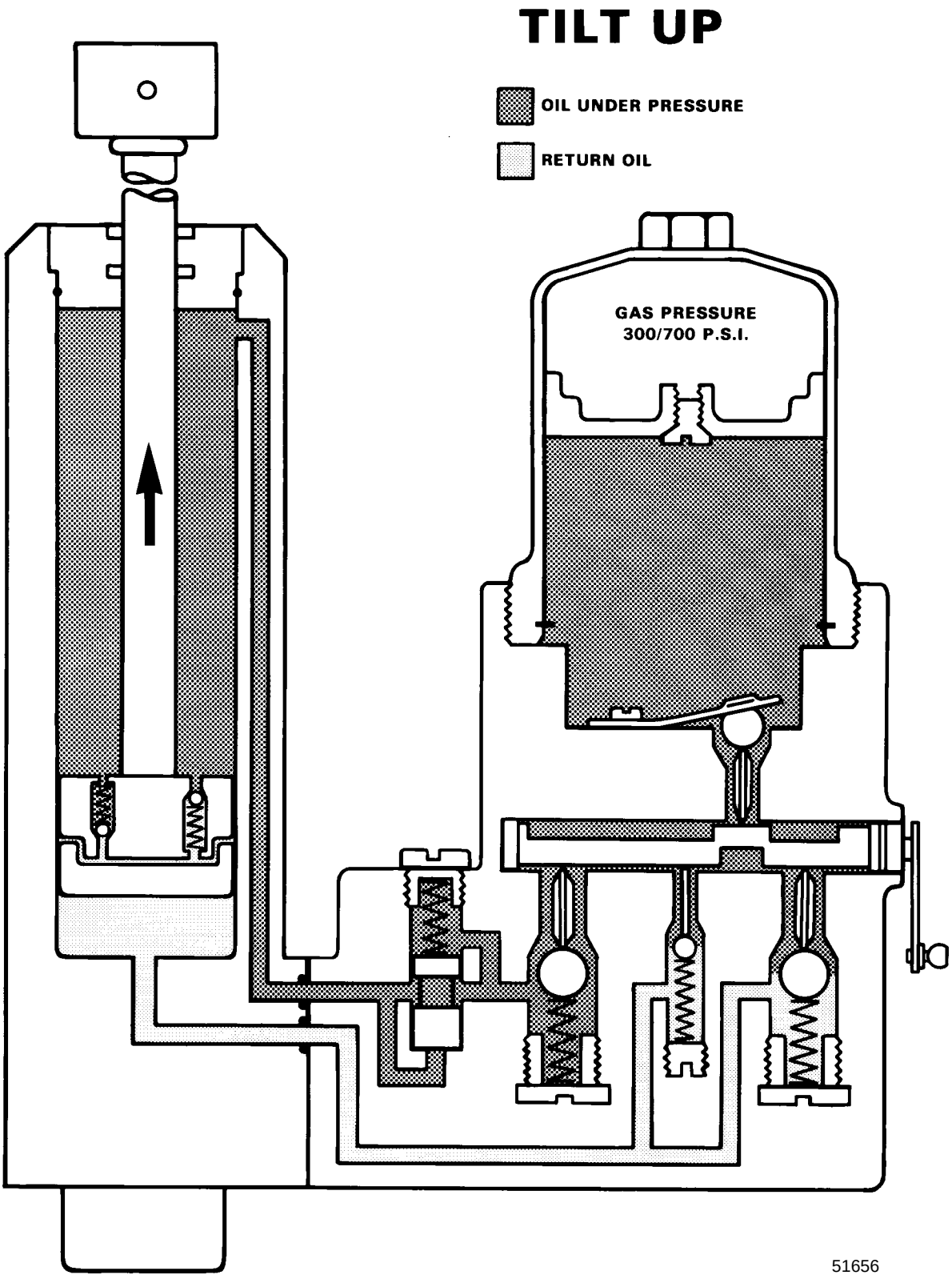
Design 1

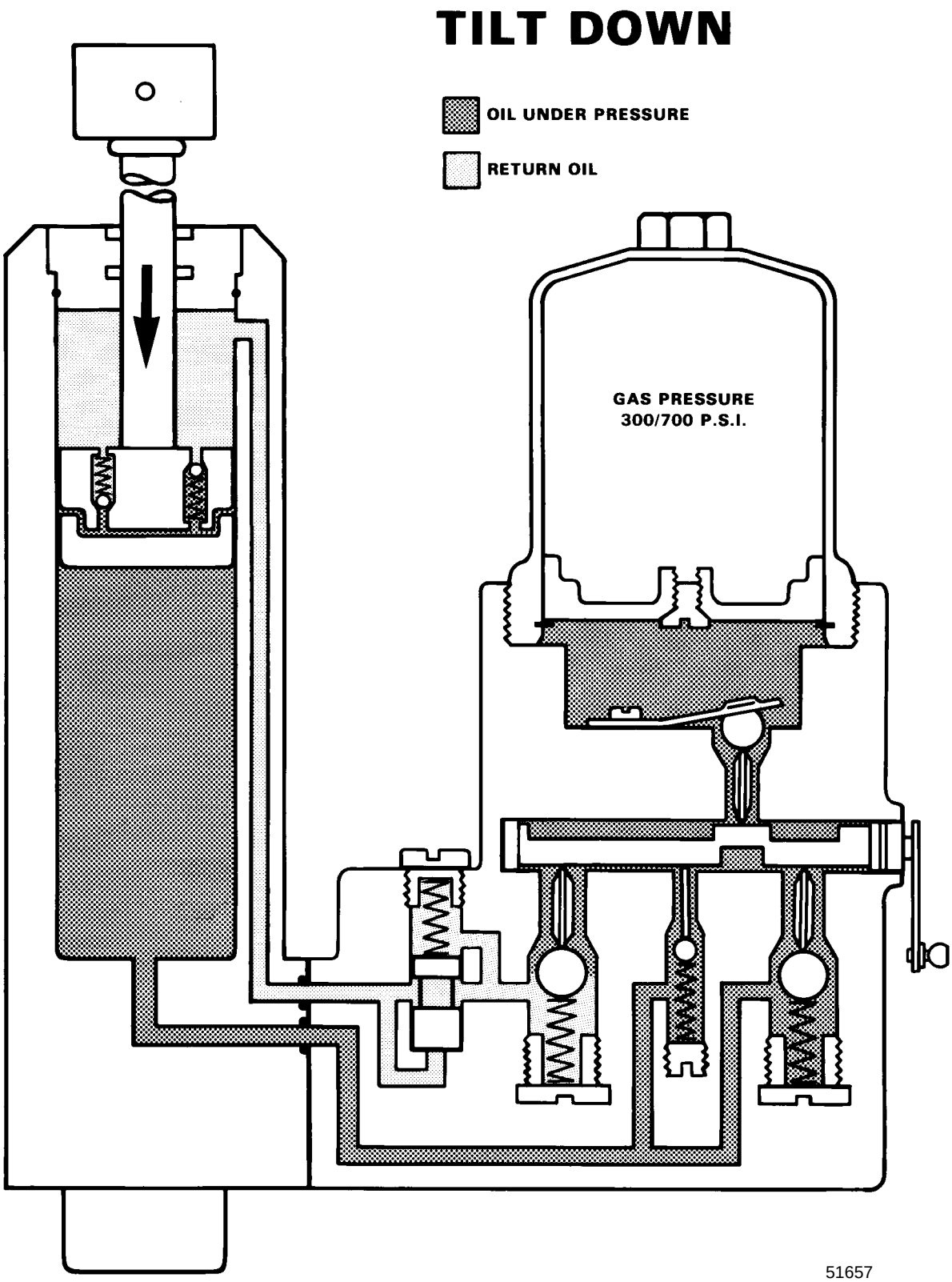

UNDER WATER STRIKE
(VALVES OPEN)
OIL UNDER PRESSURE
RETURN OIL
GAS PRESSURE
300/700 P.S.I.
51654

SHOCK FUNCTION (VALVES CLOSED)

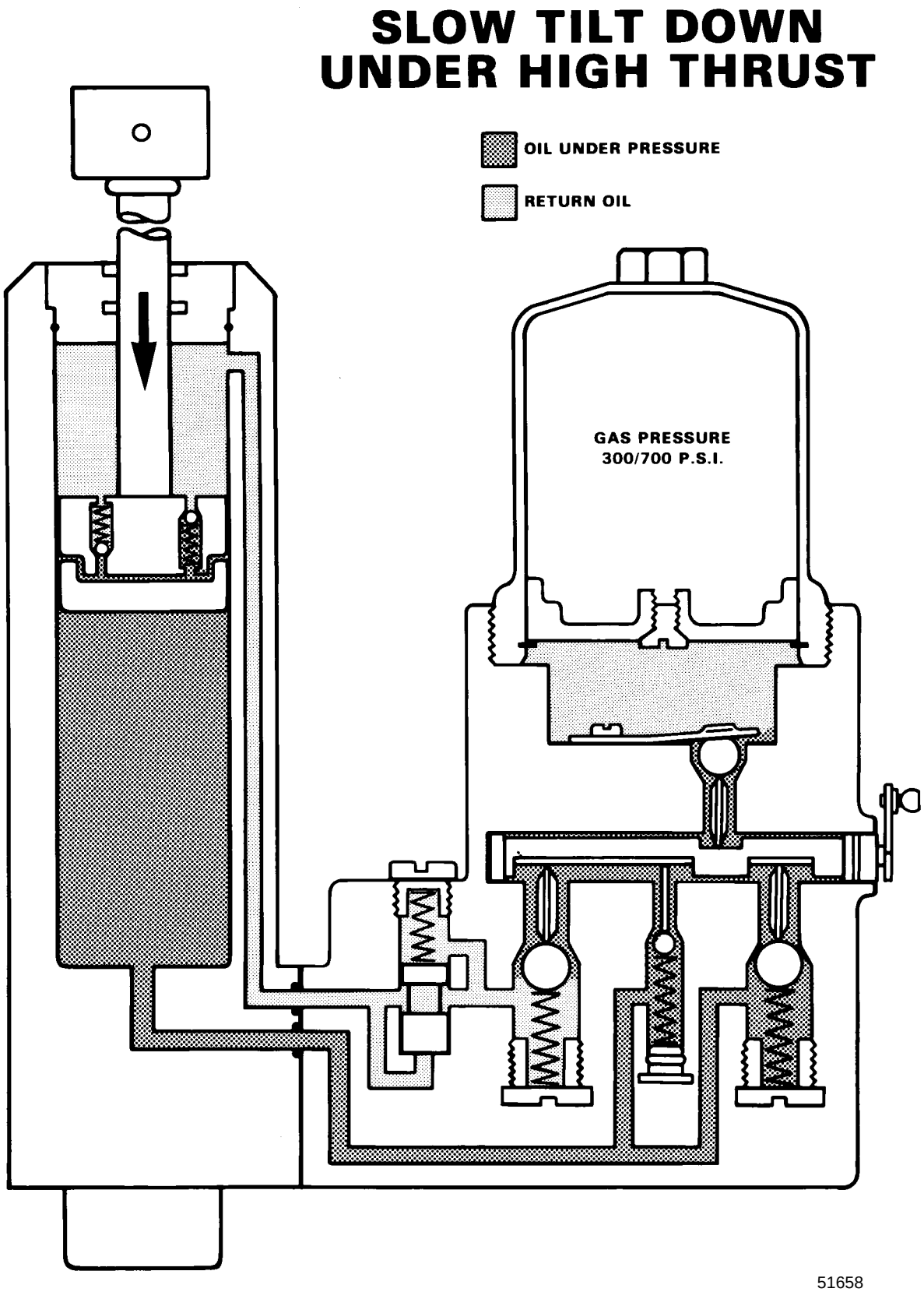


Manual Tilt Flow Diagrams
Design 2

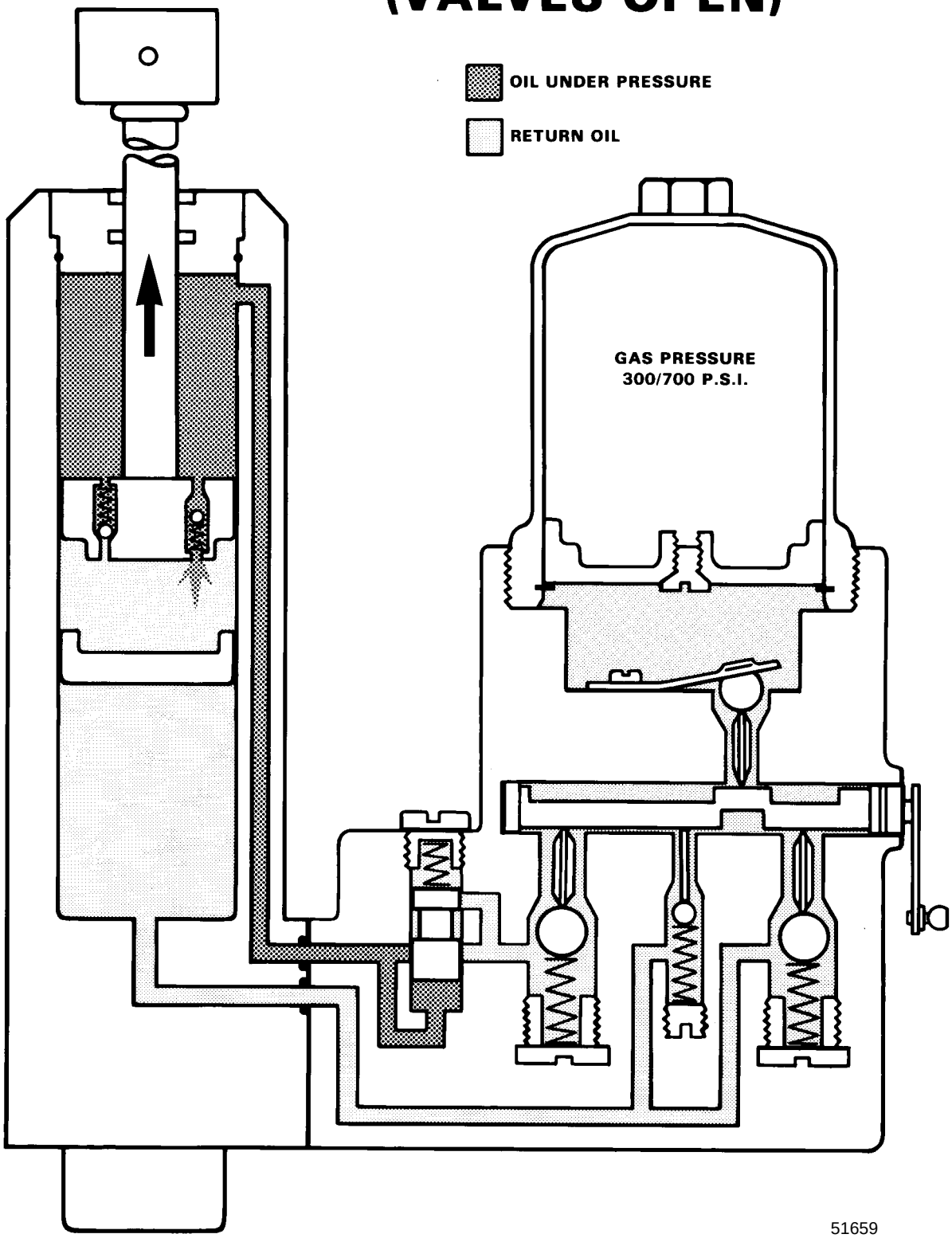



TILT DOWN
OIL UNDER PRESSURE
RETURN OIL
GAS PRESSURE
300/700 P.S.I.
51657

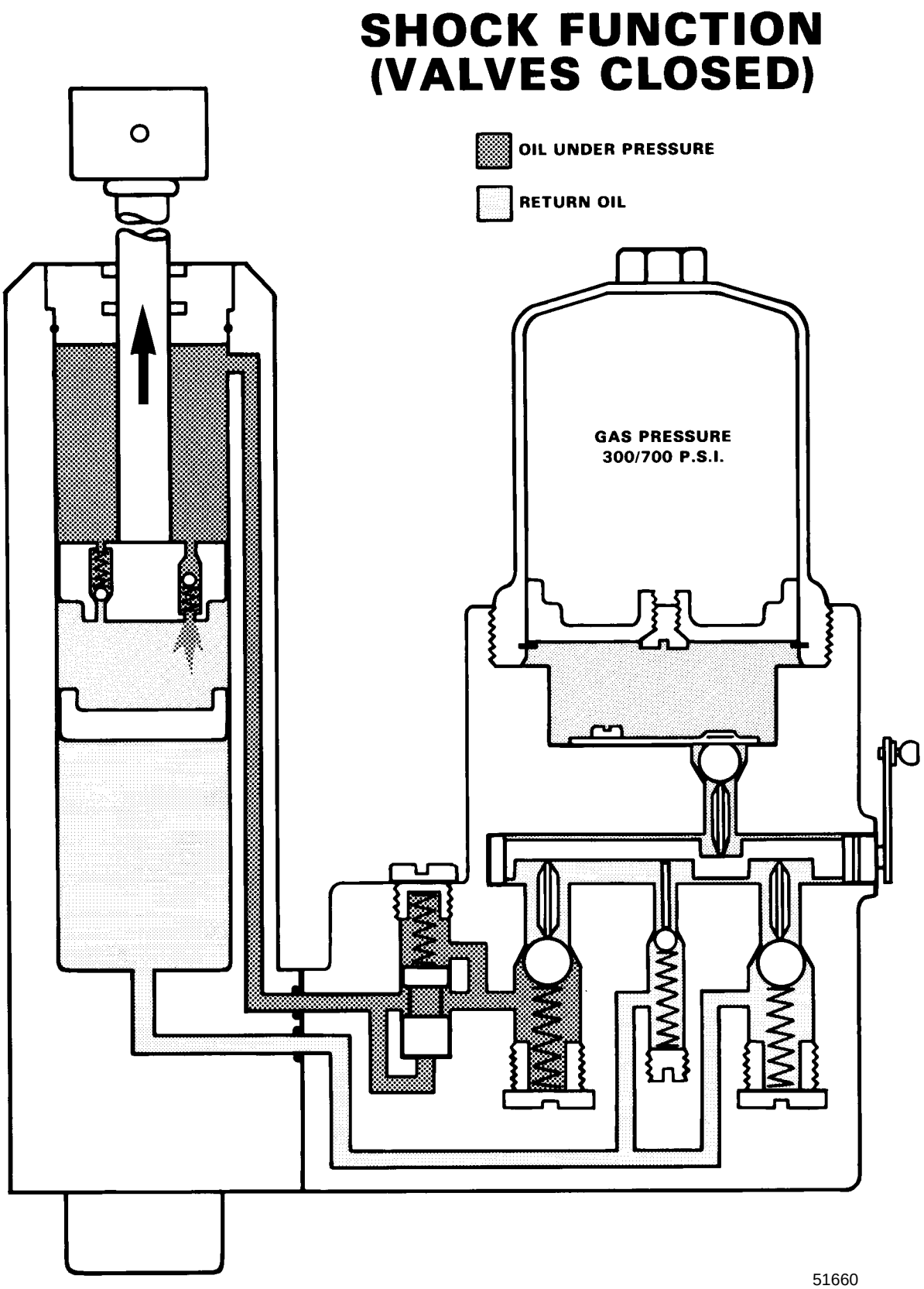
Design 2


SLOW TILT DOWN
UNDER HIGH THRUST
OIL UNDER PRESSURE
RETURN OIL
GAS PRESSURE
300/700 P.S.I.
51658

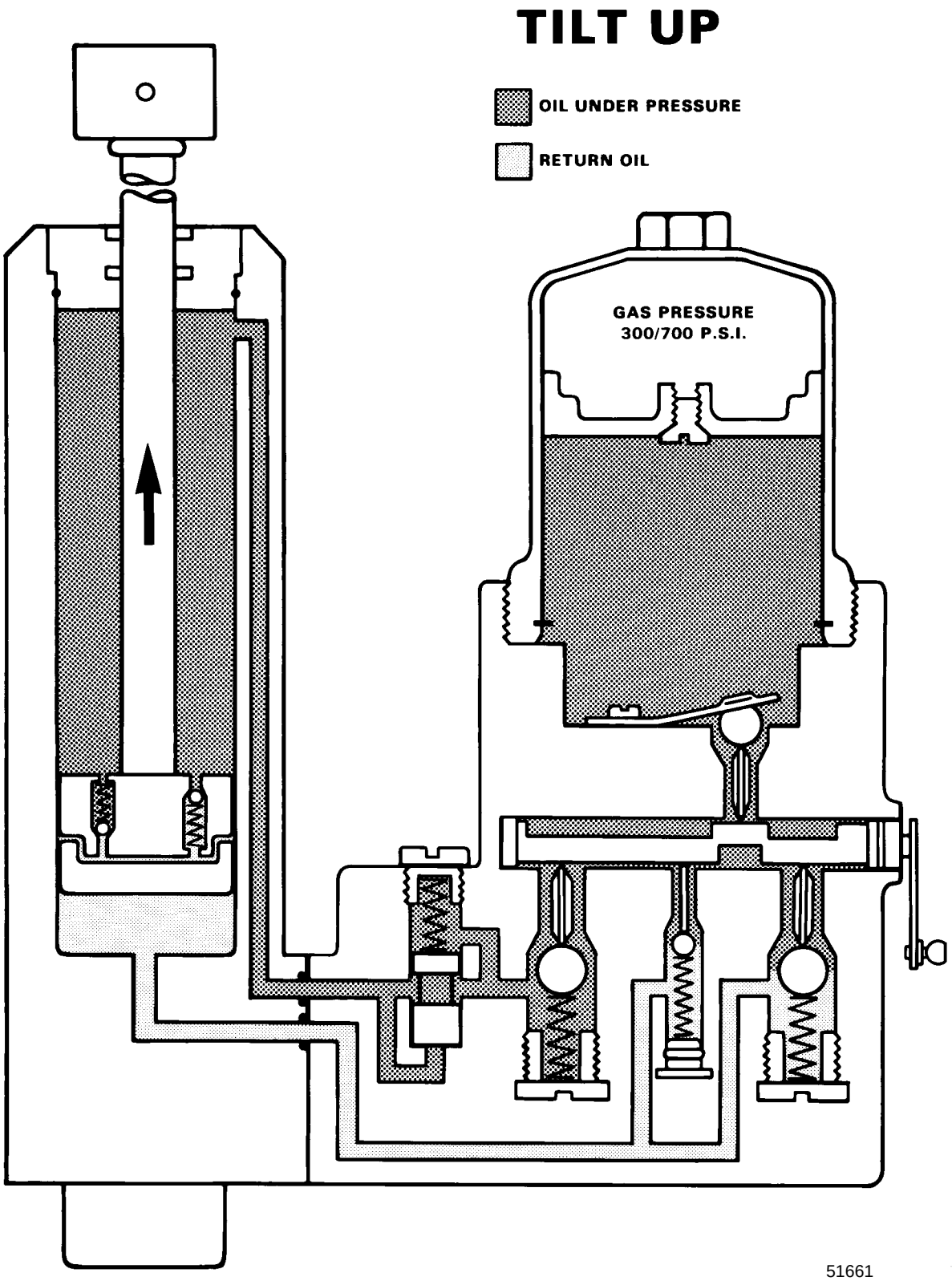
UNDER WATER STRIKE (VALVES OPEN)



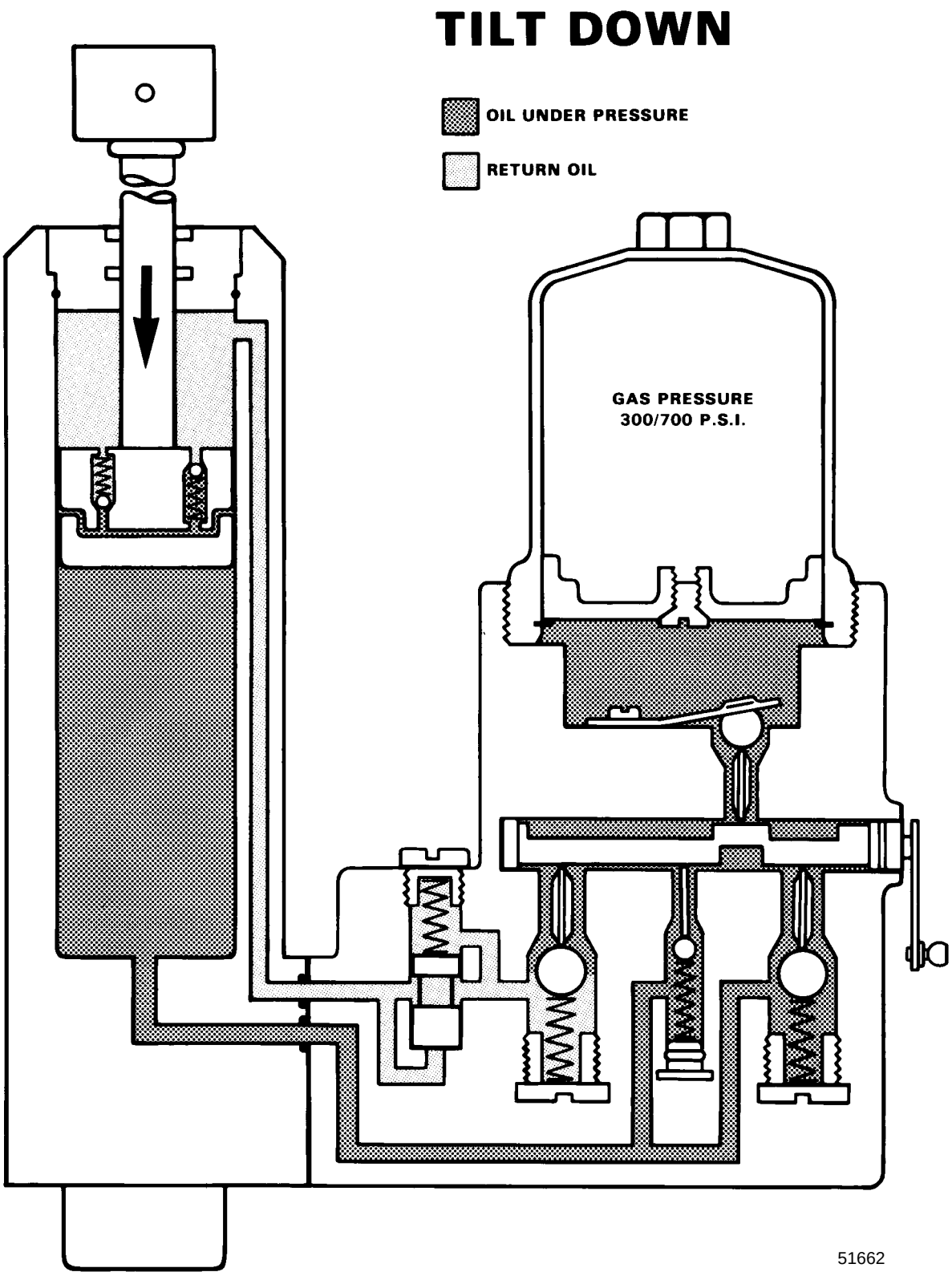
Design 2

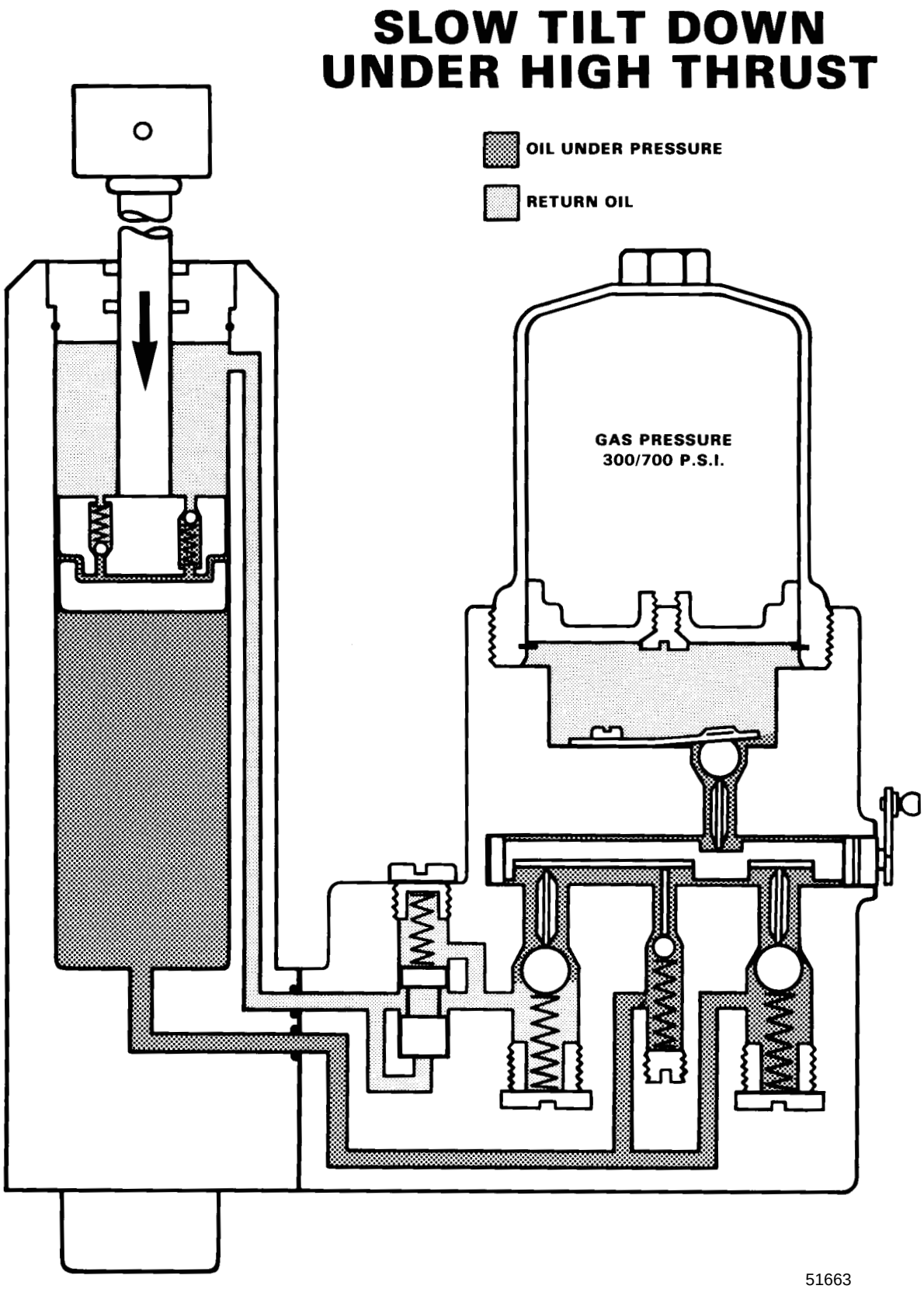

SHOCK FUNCTION
(VALVES CLOSED)
OIL UNDER PRESSURE
RETURN OIL
GAS PRESSURE
300/700 P.S.I.
51660

Manual Tilt Flow Diagrams
Design 3

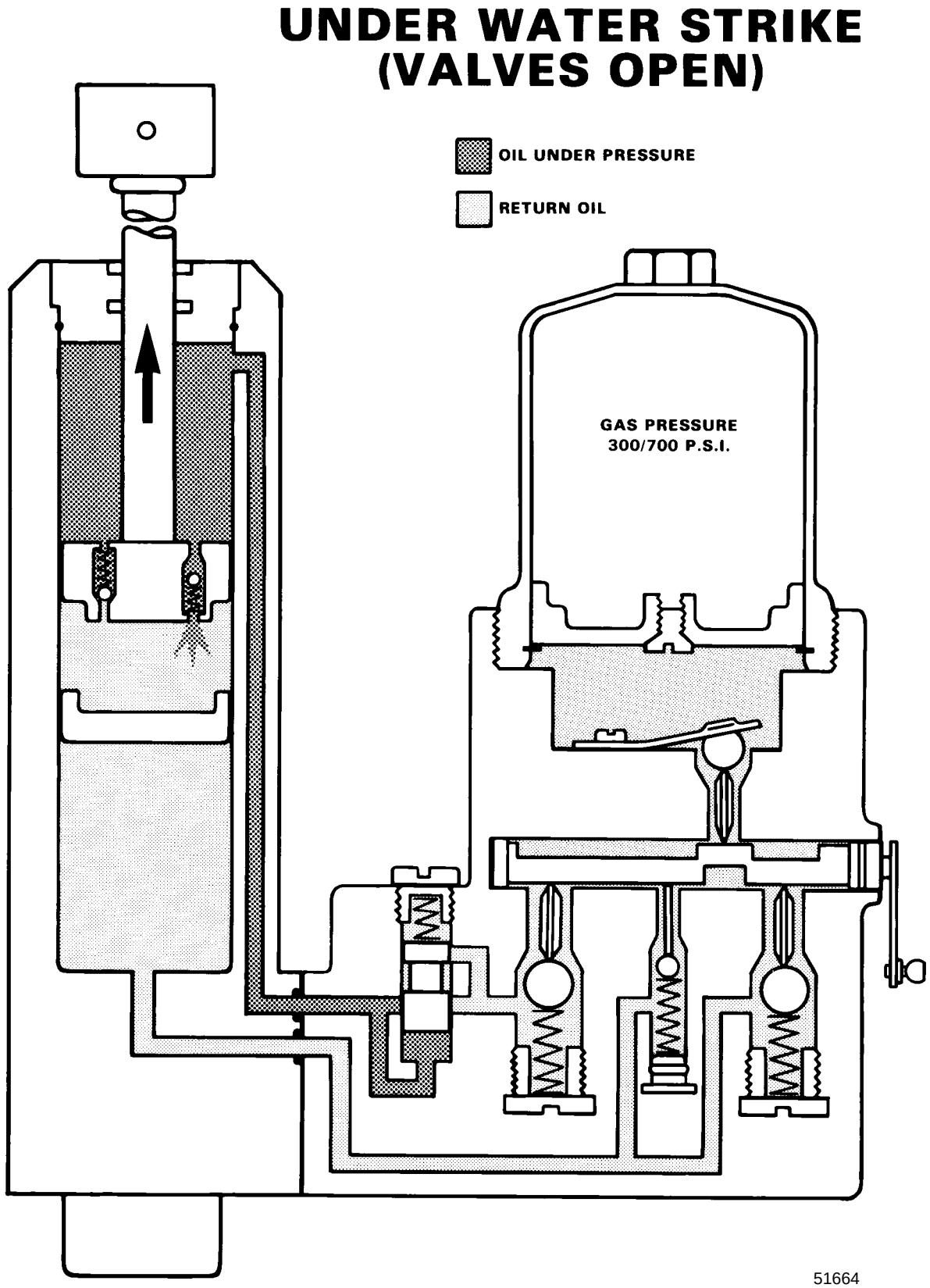


Design 3

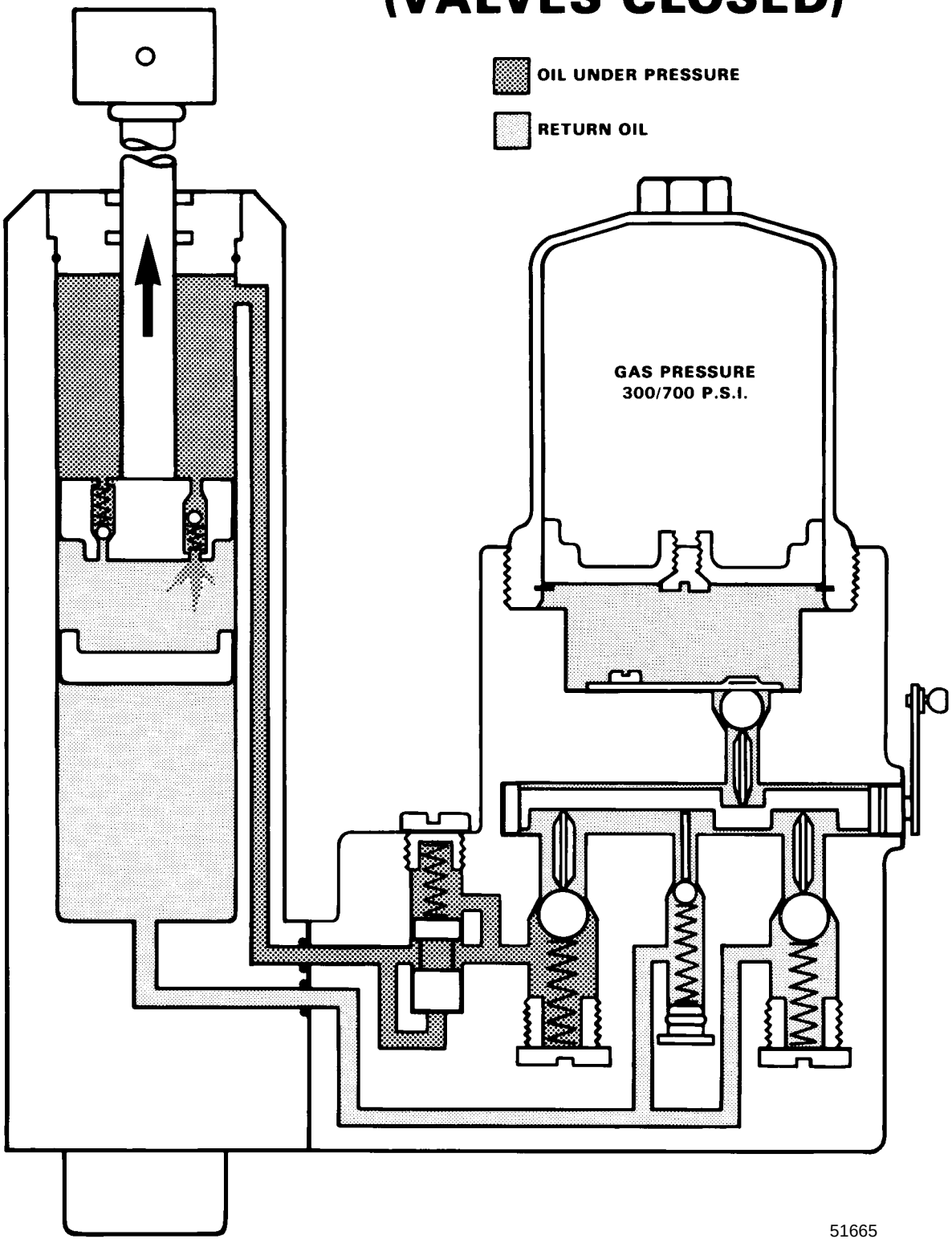

TILT DOWN
OIL UNDER PRESSURE
RETURN OIL
GAS PRESSURE
300/700 P.S.I.
51662


SLOW TILT DOWN
UNDER HIGH THRUST
OIL UNDER PRESSURE
RETURN OIL
GAS PRESSURE
300/700 P.S.I.
51663

Design 3


UNDER WATER STRIKE
(VALVES OPEN)
OIL UNDER PRESSURE
RETURN OIL
GAS PRESSURE
300/700 P.S.I.
51664

SHOCK FUNCTION (VALVES CLOSED)



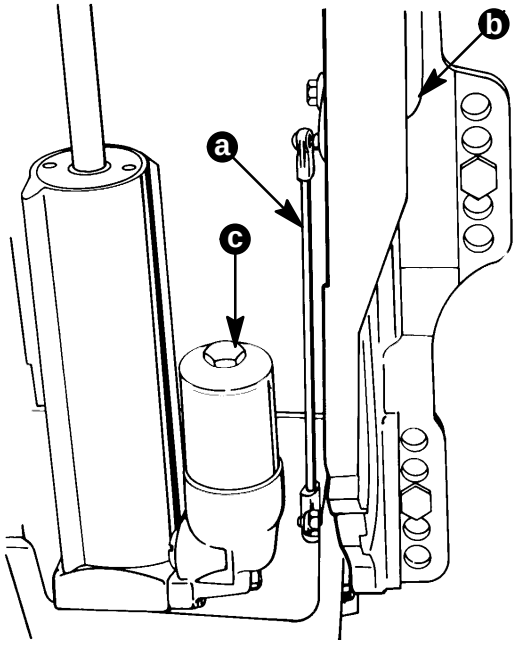
Hydraulic System Troubleshooting

Refer to disassembly/reassembly instructions (following) if disassembly is required when servicing.

IMPORTANT: After debris or failed components have been found (during troubleshooting procedure) it is recommended that unit be disassembled completely and ALL O-rings be replaced. Check ball components and castings must be cleaned using engine cleaner and compressed air or replaced prior to reassembly.

Support outboard with tilt lock lever when servicing manual tilt system.

1. Check manual release cam adjustment. Cam must open and close freely. Adjust cam link rod as necessary.



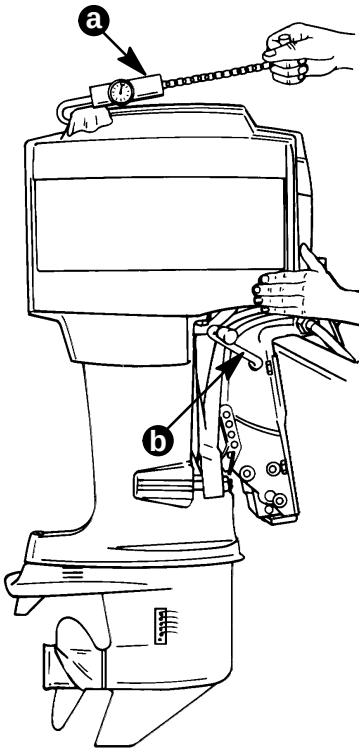
51143

a - Link Rod
b - Manual Release Lever
c - Accumulator

2. Check for external leaks in the manual tilt system. Replace defective part(s) if leak is found.

IMPORTANT: If cut or damaged O-rings are found, inspect machined surfaces for scoring, burrs or debris.

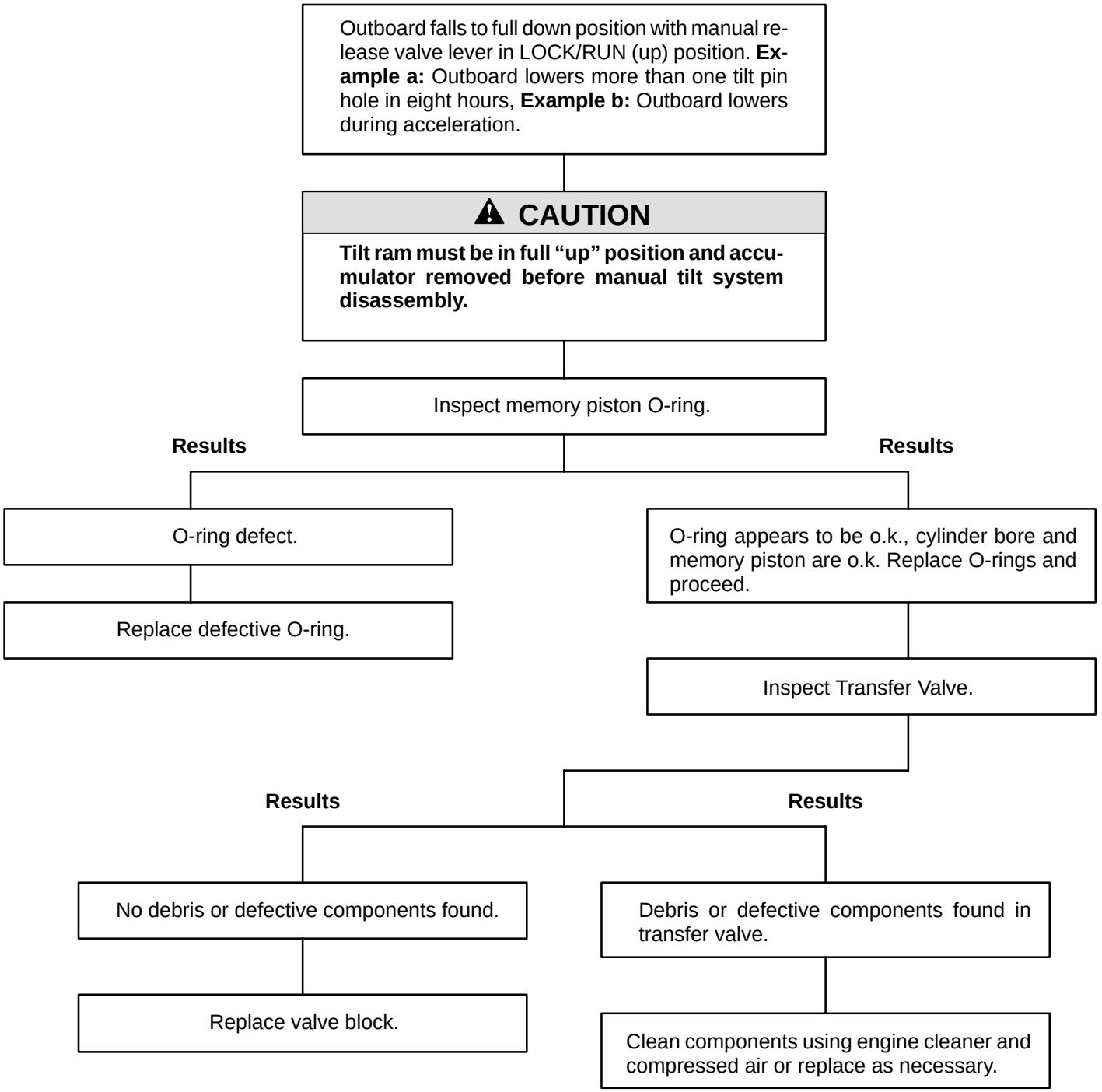
3. Check for discharged accumulator. 35 to 50 lb. ft. (47-68 N·m) of pulling force must be attained when tilting outboard from full “down” to full “up” position. If more than 50 lb. ft. (68 N·m) of force is required, replace accumulator.



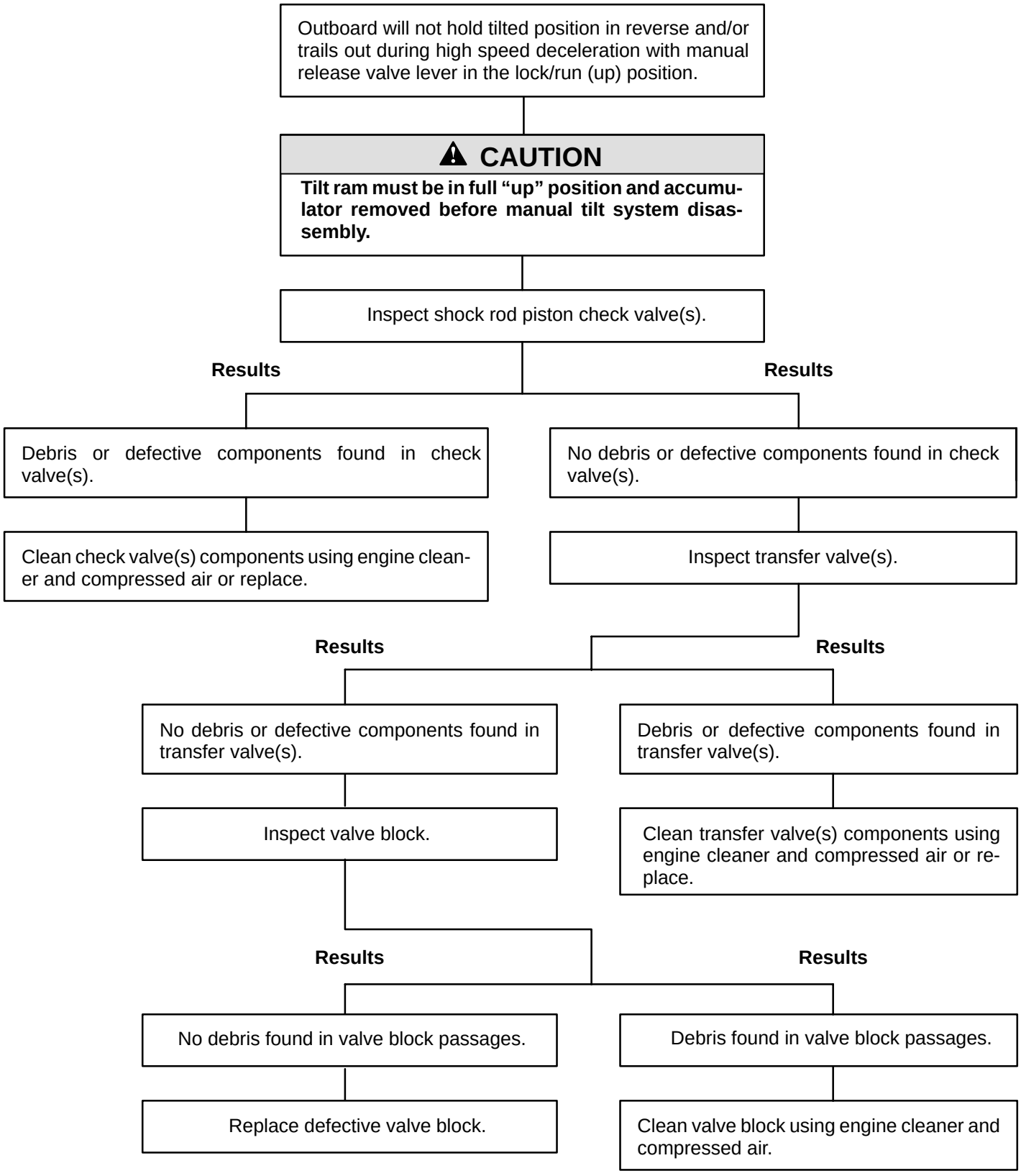
50431

a - Weight Scale
b - Valve Lever (open position)

Troubleshooting Flow Chart


Outboard falls to full down position with manual release valve lever in LOCK/RUN (up) position. **Example a:** Outboard lowers more than one tilt pin hole in eight hours, **Example b:** Outboard lowers during acceleration.
CAUTION
Tilt ram must be in full "up" position and accumulator removed before manual tilt system disassembly.
Inspect memory piston O-ring.
Results
Results
O-ring defect.
Replace defective O-ring.
O-ring appears to be o.k., cylinder bore and memory piston are o.k. Replace O-rings and proceed.
Inspect Transfer Valve.
Results
Results
No debris or defective components found.
Replace valve block.
Debris or defective components found in transfer valve.
Clean components using engine cleaner and compressed air or replace as necessary.

Troubleshooting Flow Chart (Continued)


Outboard will not hold tilted position in reverse and/or trails out during high speed deceleration with manual release valve lever in the lock/run (up) position.
CAUTION
Tilt ram must be in full "up" position and accumulator removed before manual tilt system disassembly.
Inspect shock rod piston check valve(s).
Results
Results
Debris or defective components found in check valve(s).
No debris or defective components found in check valve(s).
Clean check valve(s) components using engine cleaner and compressed air or replace.
Inspect transfer valve(s).
Results
Results
No debris or defective components found in transfer valve(s).
Debris or defective components found in transfer valve(s).
Inspect valve block.
Clean transfer valve(s) components using engine cleaner and compressed air or replace.
Results
Results
No debris found in valve block passages.
Debris found in valve block passages.
Replace defective valve block.
Clean valve block using engine cleaner and compressed air.

Manual Tilt System Removal

⚠ CAUTION

Remove cowling and remove all spark plug leads from spark plugs to prevent accidental starting while servicing outboard.

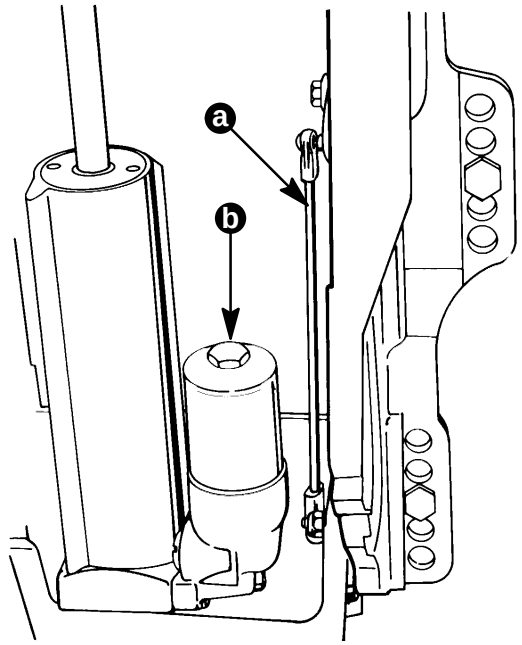
⚠ WARNING

Service or installation of the tilt system may result in loss of pressure in the shock cylinder. If the outboard is not in the full down position, such loss of pressure will cause the engine to fall to the full down position with a potential for damaging engine or causing personal injury. To avoid such injury support outboard in the up position using tilt lock lever.

⚠ WARNING

Manual tilt system is pressurized. Accumulator must be removed when shock rod is in the full up position, prior to servicing, otherwise oil spray-back may occur.

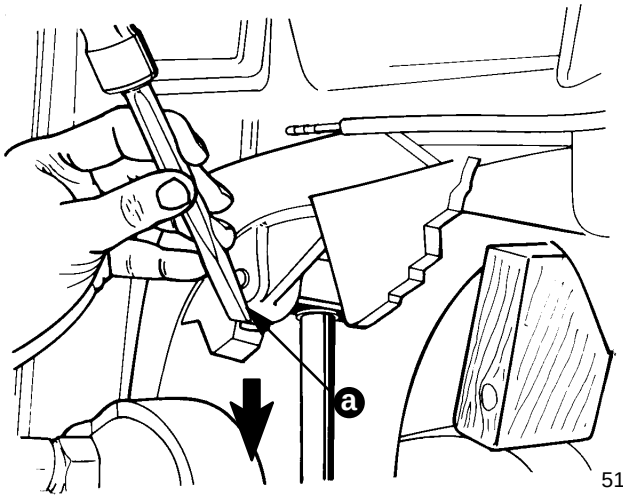
1. Support outboard in the up position using tilt lock lever.
2. Remove link rod.



51143

a - Link Rod
b - Accumulator

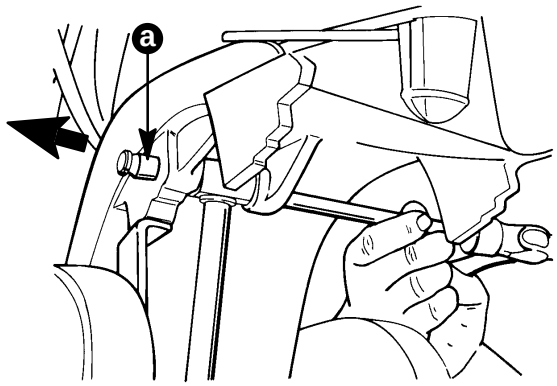
3. Use suitable punch to remove (DRIVE DOWN) upper dowel pin. Retain dowel pin.



51144

a - Dowel Pin

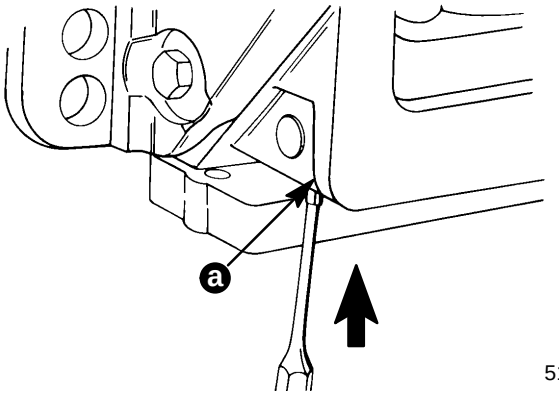
4. Use suitable punch to drive out upper pivot pin.



51144

a - Pivot Pin

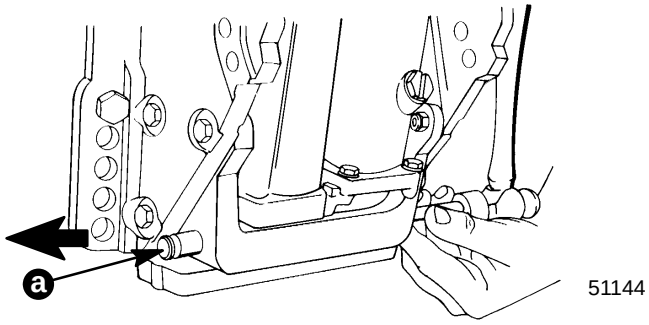
5. Use punch to remove (DRIVE UP) lower dowel pin. Retain dowel pin.



51144

a - Dowel Pin

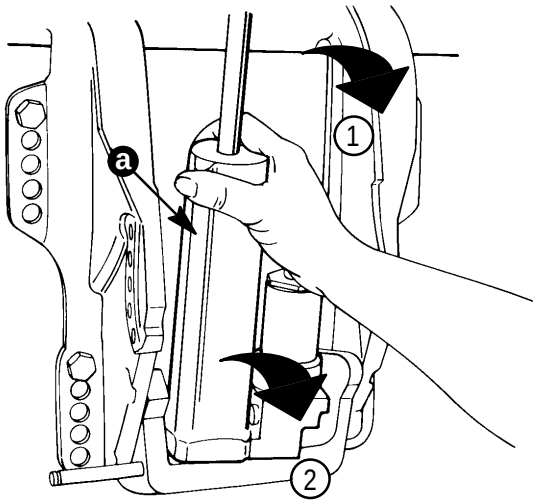
6. Use suitable punch to drive out lower pivot pin.



51144

a - Pivot Pin

7. Tilt shock absorber assembly (TOP FIRST) out from clamp bracket and remove assembly.



51144

a - Manual Tilt System

Manual Tilt System Disassembly

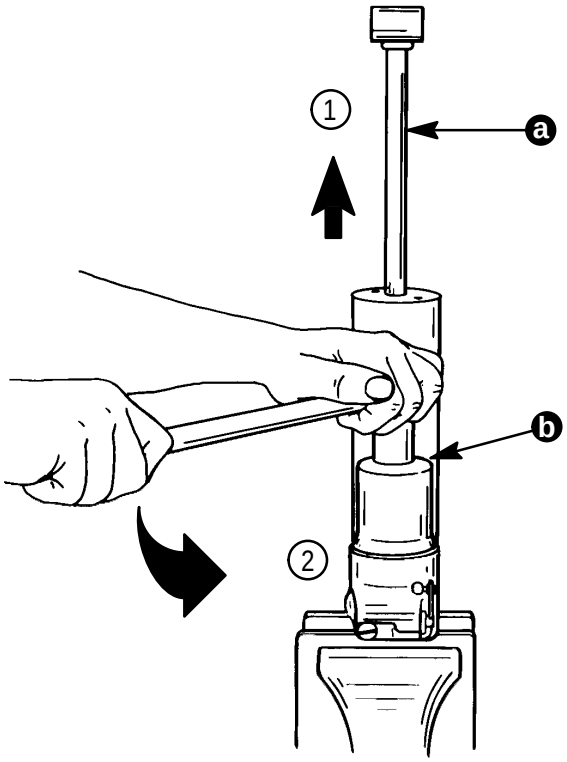
NOTE: *Accumulator contains a high pressure nitrogen charge and is NOT SERVICEABLE. Replace if necessary.*

⚠ WARNING

This tilt system is pressurized. Remove accumulator only when shock rod is in full up position.

Accumulator Removal

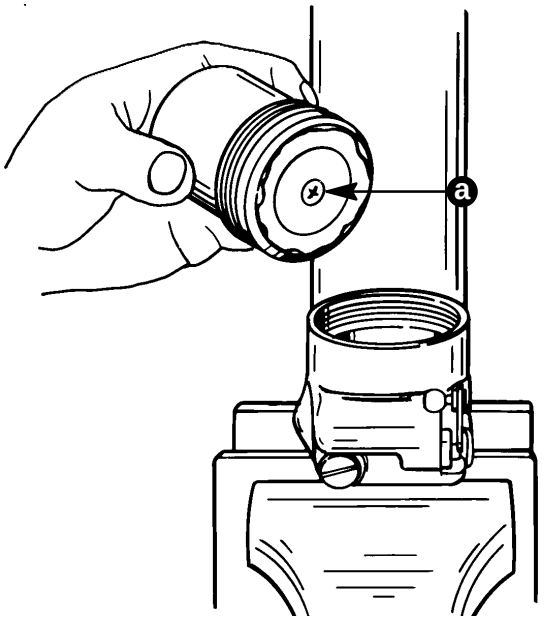
1. Place manual tilt system in soft jawed vise.
2. Position shock rod to full up position.
3. Remove accumulator



51143

a - Shock Rod
b - Accumulator

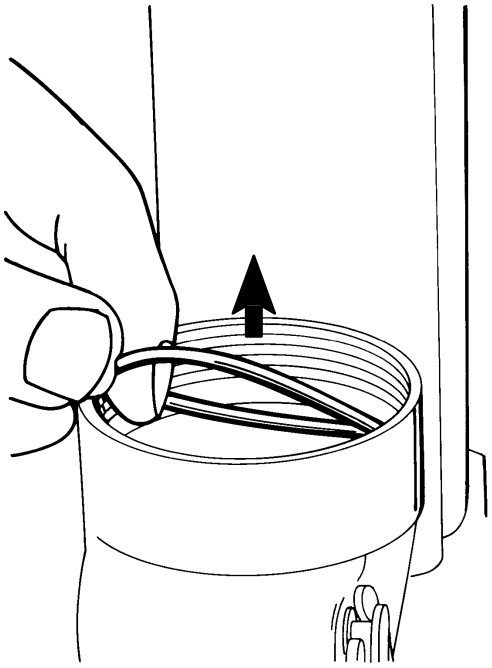
4. If plunger can be compressed into accumulator by hand, accumulator is defective. Replace accumulator.



51143

a - Plunger

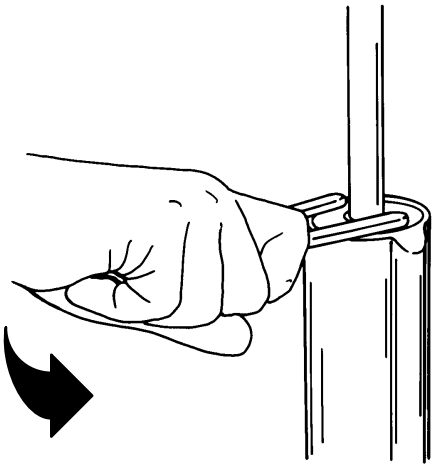
5. Remove O-ring.



51145

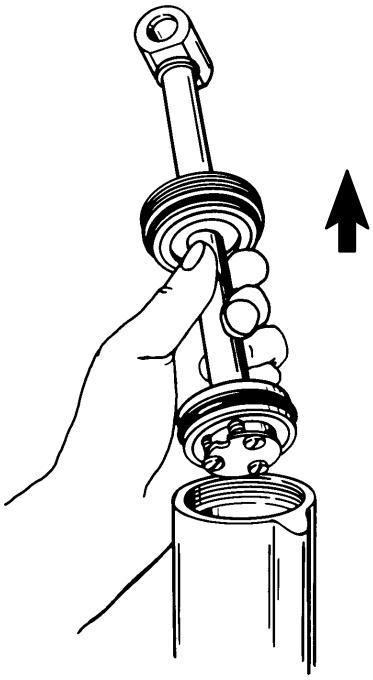
Shock Rod Removal

1. Remove cylinder end cap assembly using spanner wrench [1/4 in. x 5/16 in. long pegs].



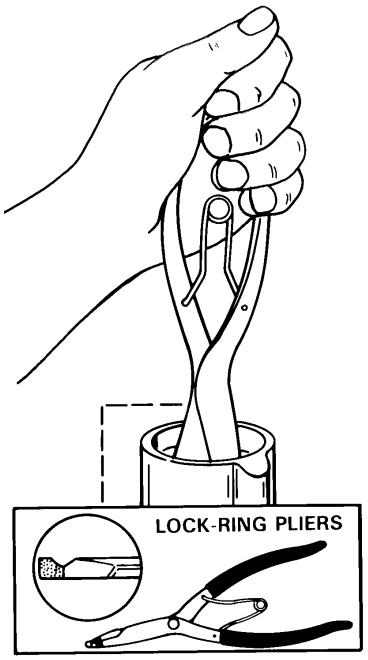
51145

2. Remove shock rod assembly.



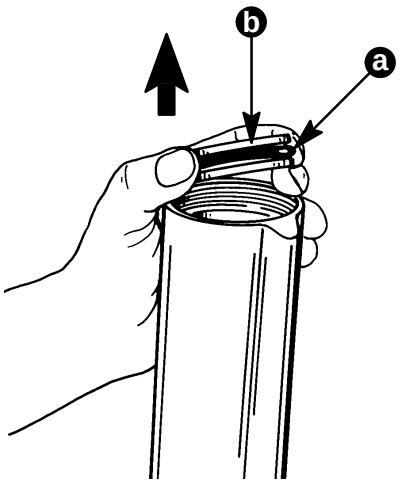
51143

3. Remove memory piston from cylinder using lock ring pliers (Craftsman P/N 4735) or suitable tool.



51144

4. Remove O-ring from memory piston.



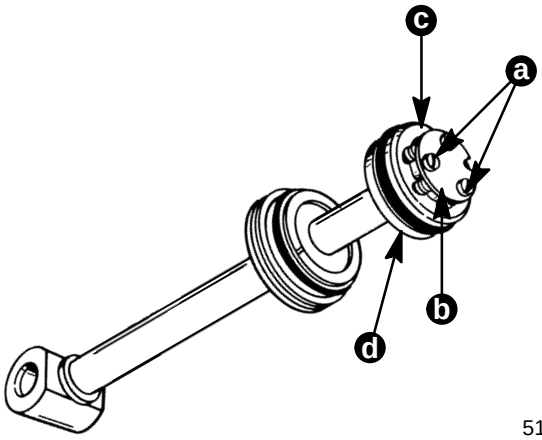
51144

a - O-ring
b - Memory Piston

5. Remove tilt system from vise and empty fluid into appropriate container.

Shock Rod Disassembly

1. Place shock rod assembly on clean work surface.
2. Remove plate and O-ring.
3. Remove check ball components from shock rod piston.



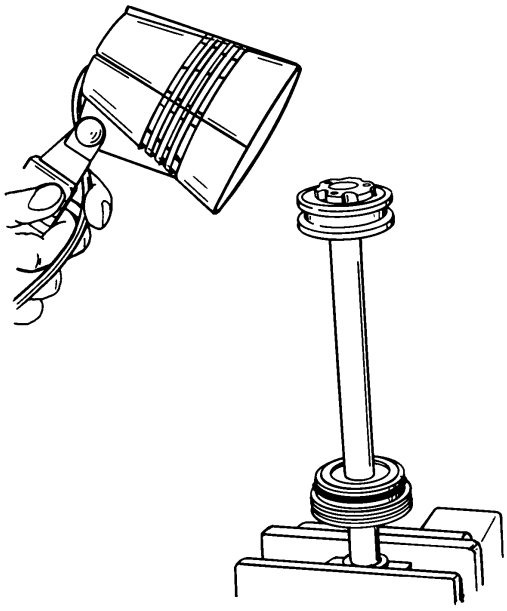
51143

a - Screw (3)
b - Plate
c - O-ring
d - Shock Rod Piston

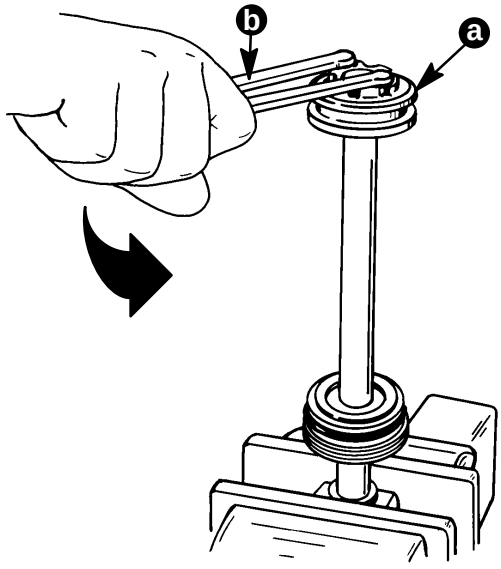
⚠ CAUTION

When removing shock piston, spanner wrench must have 1/4 in. x 5/16 in. long pegs to avoid damage to shock piston.

4. Place shock rod into soft jawed vise and apply heat to loosen piston using torch lamp (P/N 91-63209).
5. Loosen shock rod piston using spanner wrench [1/4 in. x 5/16 in. (6.4mm x 8mm) long pegs].
6. Allow shock rod piston to cool. Remove from shock rod.



51146



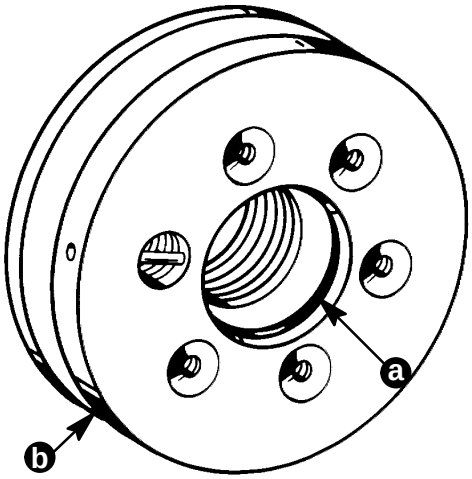
51146

a - Shock Rod Piston
b - Spanner Wrench

⚠ CAUTION

Do not remove check ball components from shock rod piston. Removal and reinstallation of check valve could result in improper operating pressure and possible manual tilt system damage.

7. Inspect check valve for debris; clean debris from check valve if found. If debris cannot be cleaned from check valve, replace shock piston as an assembly.
8. Clean shock and components with compressed air.
9. Remove inner O-ring.



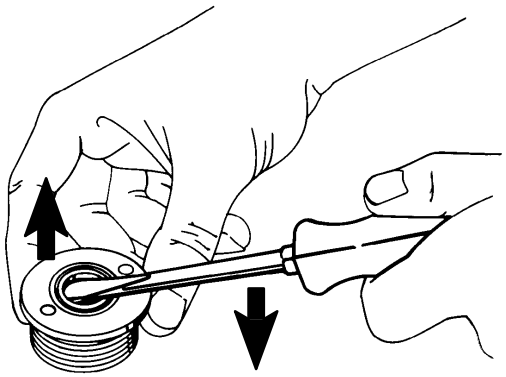
51199

a - O-ring
b - Shock Piston

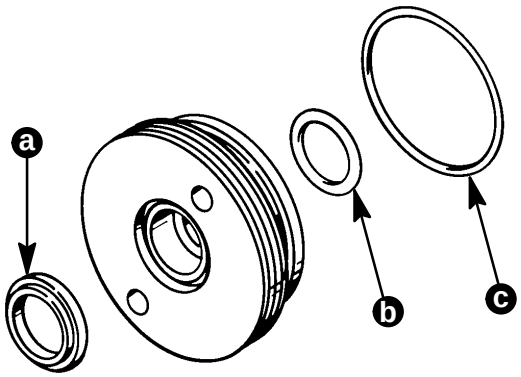
10. Remove cylinder end cap assembly from shock rod.
11. Inspect shock. If wiper (located in cap) has failed to keep rod clean, replace wiper.

12. Place end cap on clean work surface.

13. Remove rod wiper, inner O-ring, and outer O-ring.



51147

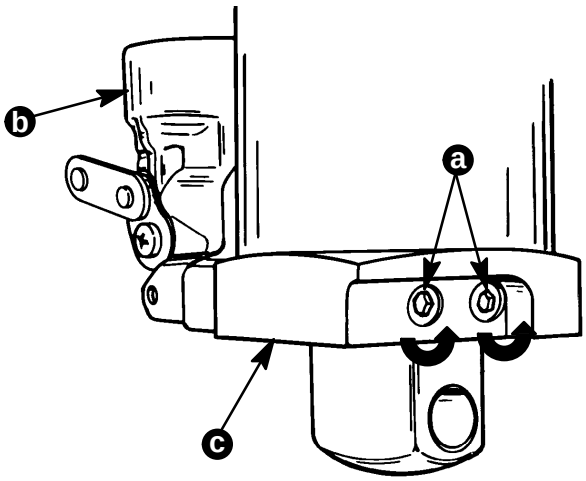


51145

a - Rod Wiper
b - Inner O-ring
c - Outer O-ring

Valve Block Removal

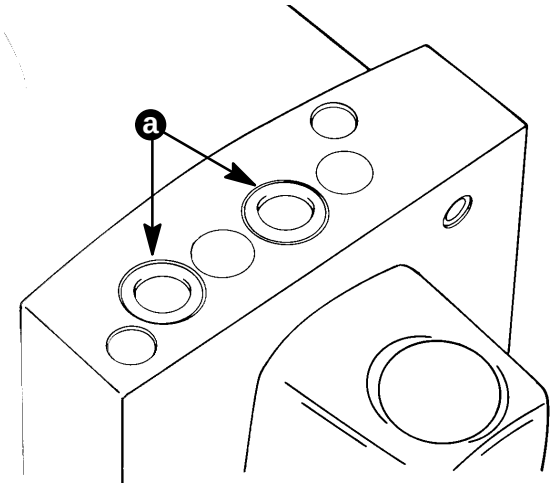
1. Remove valve block from shock rod cylinder.



51146

a - Screws (2)
b - Valve Block
c - Shock Rod Cylinder

2. Remove O-rings.

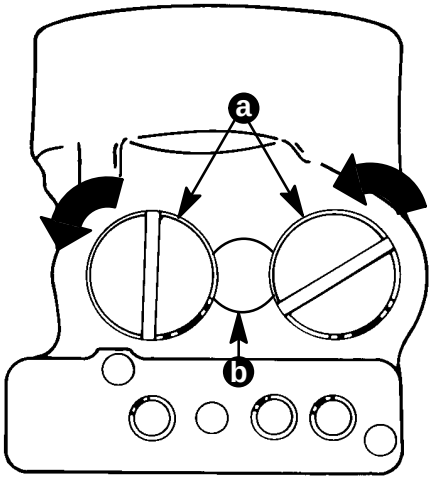


51148

a - O-rings (2)

Valve Block Disassembly

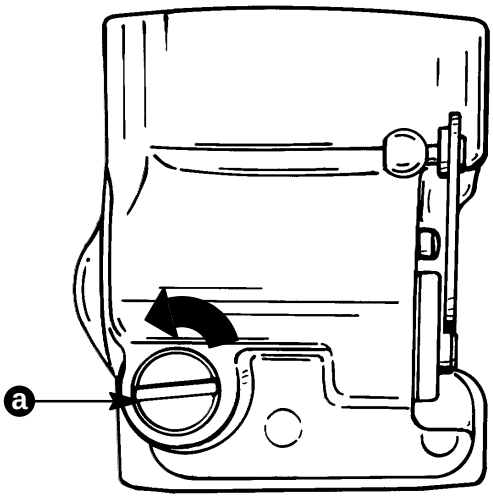
1. Remove slow trim valve assembly.
2. Remove hydraulic oil transfer valve components.



51143

a - Transfer Valves (2)
b - Slow trim Valve Assembly (Plug or Screw Plug)

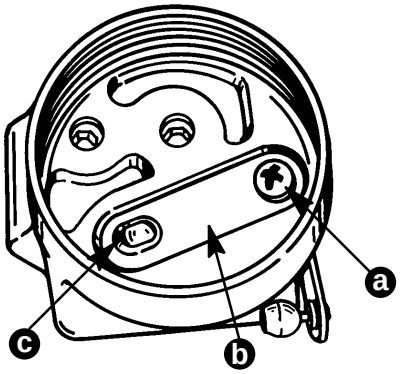
3. Remove surge valve assembly.



51145

a - Surge Valve

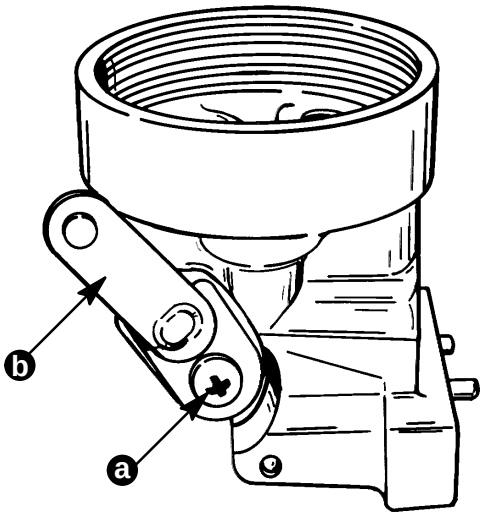
4. Remove reservoir assembly.



51142

a - Screw
b - Flat Spring
c - Ball

5. Remove cam assembly.



51145

a - Screw
b - Cam Assembly

Manual Tilt System Cleaning and Inspection

1. It is recommended that all O-rings exposed during disassembly be replaced.
2. Clean components, filter, and check valve seats using engine cleaner and compressed air. Do not use cloth rags.
3. Inspect all machined surfaces for burrs or scoring to assure O-ring longevity.
4. Inspect shock rod. If wiper (located in cap) has failed to keep rod clean, replace wiper.

Manual Tilt System Reassembly

IMPORTANT: Components must be dirt and lint free. Slightest amount of debris in tilt system could cause system to malfunction.

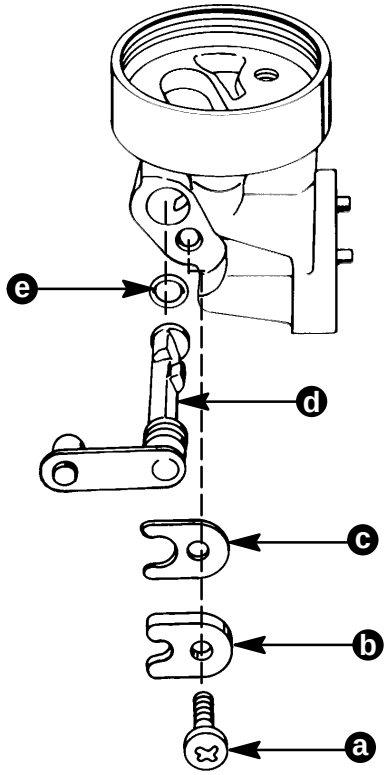
Apply Quicksilver Power Trim and Steering Fluid or, (ATF) Type F, FA or Dexron II on all O-rings during reassembly.

NOTE: *Refer to "Manual Tilt System Components" for proper O-ring sizes.*

Valve Block Reassembly

IMPORTANT: Cam shaft O-ring must be lubricated using Special Lubricant 101 prior to installation.

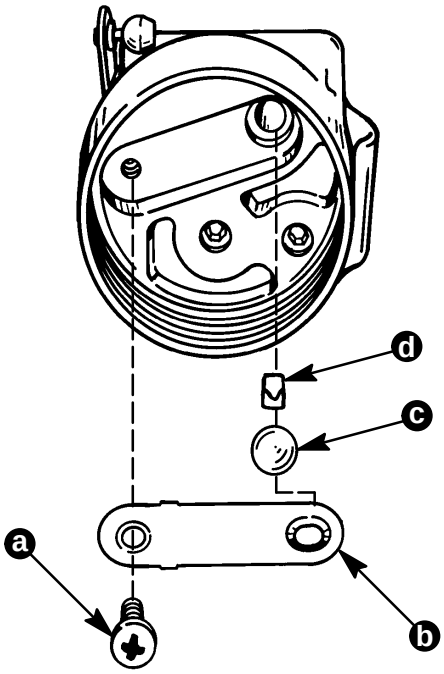
1. Install lubricated O-ring to cam shaft.
2. Install cam shaft in valve block.
3. Secure cam shaft in place using insulator, retainer plate, and screw. Tighten screw securely.



51142

a - Screw
b - Retainer Plate
c - Insulator
d - Cam Shaft
e - O-ring

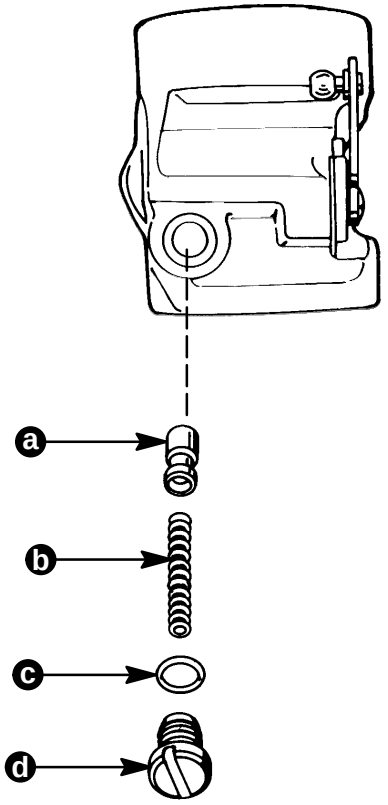
4. Install push rod, ball, flat spring and screw in valve block.
5. Torque screw to 27 lb. in. (3.0 N·m).



51145

a - Screw
b - Flat Spring
c - Ball
d - Push Rod

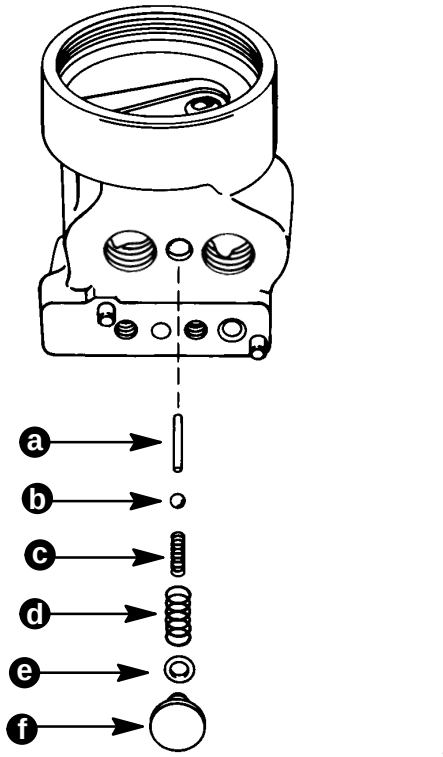
6. Install spool, spring, lubricated O-ring and screw plug (surge valve assembly) into valve block.
7. Torque screw plug to 75 lb. in. (8.5 N·m).



51142

a - Spool
b - Spring
c - O-ring
d - Screw Plug

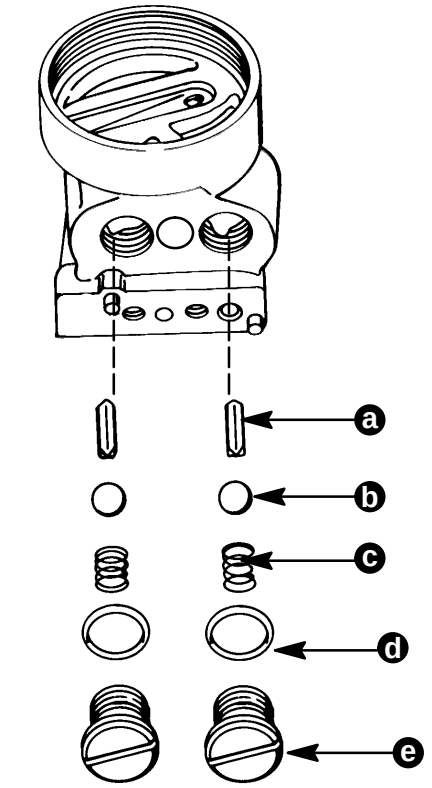
8. Install push rod, ball, spring, lubricated O-rings and screw plug (transfer valve components) in valve block.
9. Install plunger, ball, spring (small), spring (large) in valve block (Slow Trim Valve Assembly).
10. Apply Loctite Pipe Sealant with Teflon 592 to threads of pipe plug (design one and two style valve block).
11. Install pipe plug or plug into valve block. Tighten pipe plug (if equipped) securely.



51142

a - Plunger
b - Ball
c - Spring (Small)
d - Spring (Large)
e - O - ring
f - Plug (Design 3)

12. Torque screw plug to 75 lb. in. (8.5 N·m).

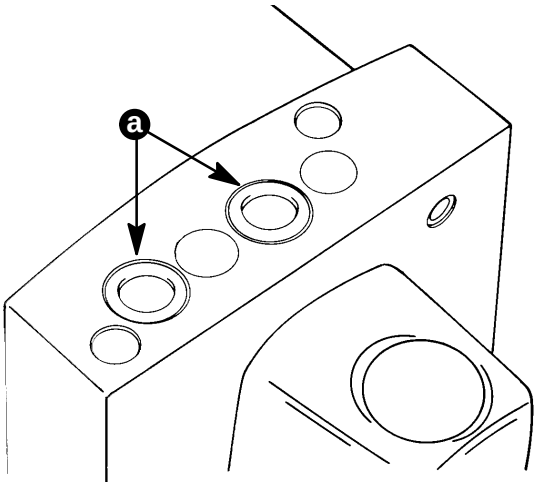


51142

a - Push Rod (2)
b - Ball (2)
c - Spring (2)
d - O-ring (2)
e - screw Plug (2)

Valve Block Installation

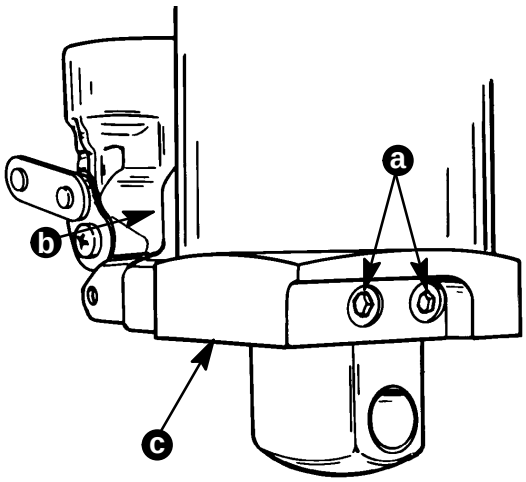
1. Install lubricated O-rings.



51148

a - O-rings (2)

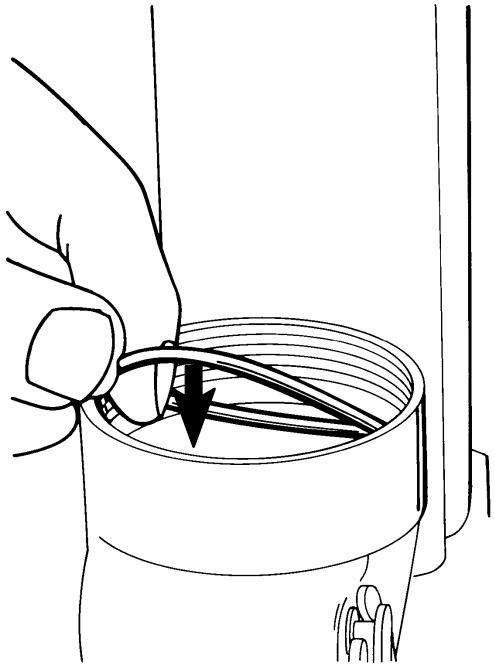
2. Install valve block to shock rod cylinder. Torque screws to 100 lb. in. (11.5 N·m).



51146

a - Screw (2)
b - Valve Block
c - Shock Rod Cylinder

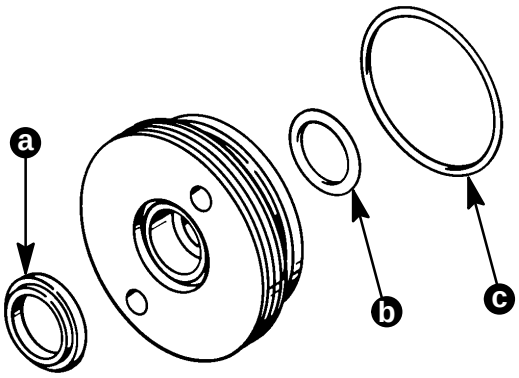
3. Install lubricated O-ring.



51145

Shock Rod Reassembly

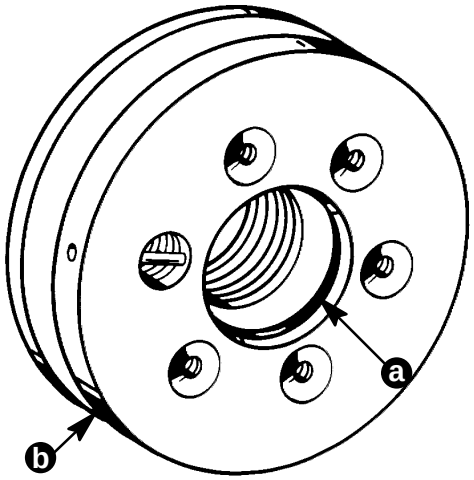
1. Install lubricated O-rings.
2. Install rod wiper.



51145

a - Rod Wiper
b - Inner O-ring
c - Outer O-ring

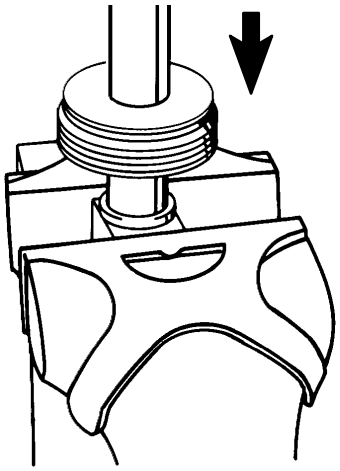
3. Install lubricated O-ring.



51199

a - O-ring
b - Shock Piston

4. Clamp shock rod in soft jawed vise.
5. Position cylinder end cap onto rod as shown.

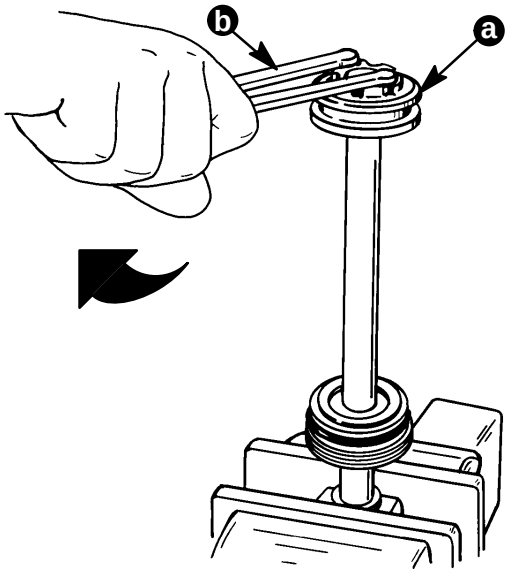


51146

⚠ CAUTION

When installing shock rod piston, spanner wrench must have1/4 in. x 5/16 in. (6.4mm x8mm) long pegs to avoid damage to shock rod piston.

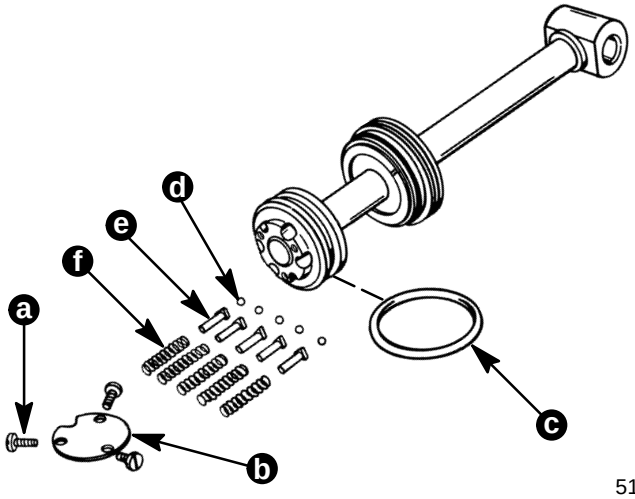
6. Apply Loctite 271 to threads on shock rod.
7. Install shock rod piston.
8. Tighten shock rod piston securely using spanner wrench (1/4 in. x 5/16 in. long pegs).



51146

a - Shock Rod Piston
b - Spanner Wrench

9. Remove shock rod assembly from vise.
10. Install lubricated O-ring to shock rod piston.
11. Install ball, seat, and spring (five sets) to shock rod piston.
12. Secure components with plate. Torque screws to 35 lb. in. (4.0 N·m).

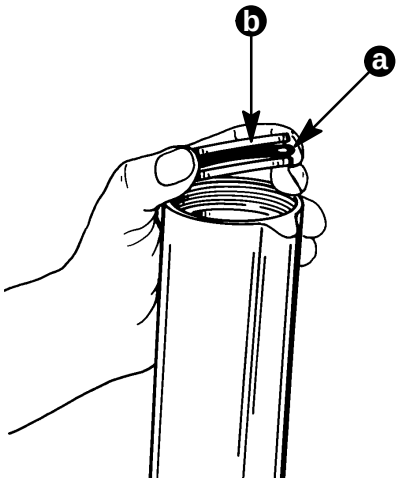


51147

a - Screw (3)
b - Plate
c - O-ring
d - Ball (5)
e - Seat (5)
f - Spring (5)

Shock Rod Installation

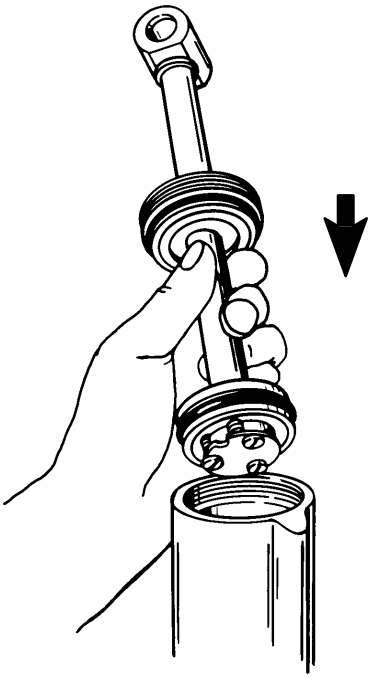
1. Place cylinder/manifold assembly into soft jawed vise.
2. Fill cylinder to top using Quicksilver Power Trim and Steering Fluid or; (ATF) Type F, FA of Dexron II.
3. Place cam shaft lever in the open position (lever facing down).
4. Install lubricated O-ring to memory piston and install piston into cylinder three inches (76mm) from top.



51144

a - O-ring
b - Memory Piston

5. Refill cylinder to top and install shock rod assembly into cylinder.



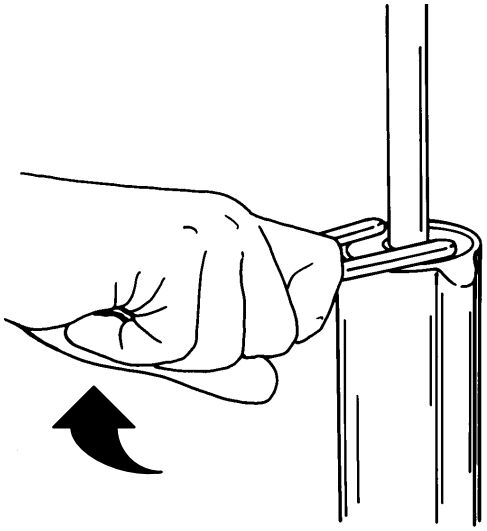
51143

6. Refill cylinder to top.

⚠ CAUTION

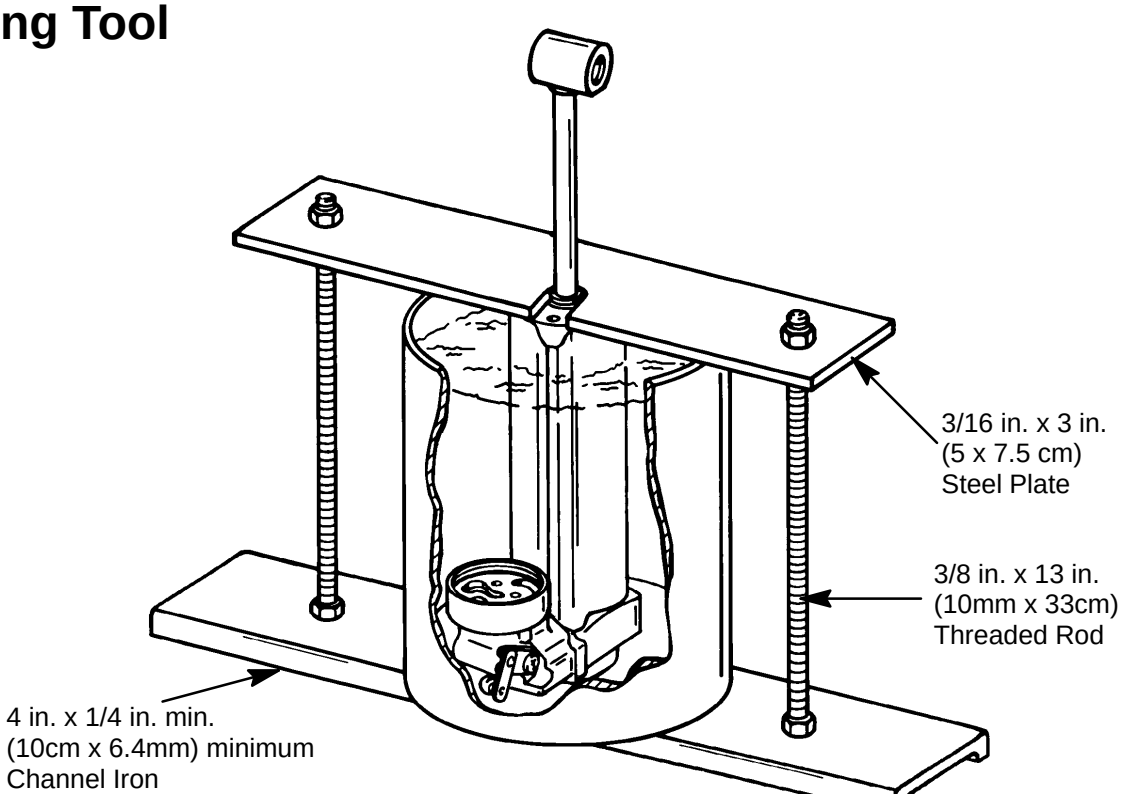
End cap must not make contact with shock rod piston when tightening. Shock rod piston must be positioned in cylinder deep enough to avoid contact.

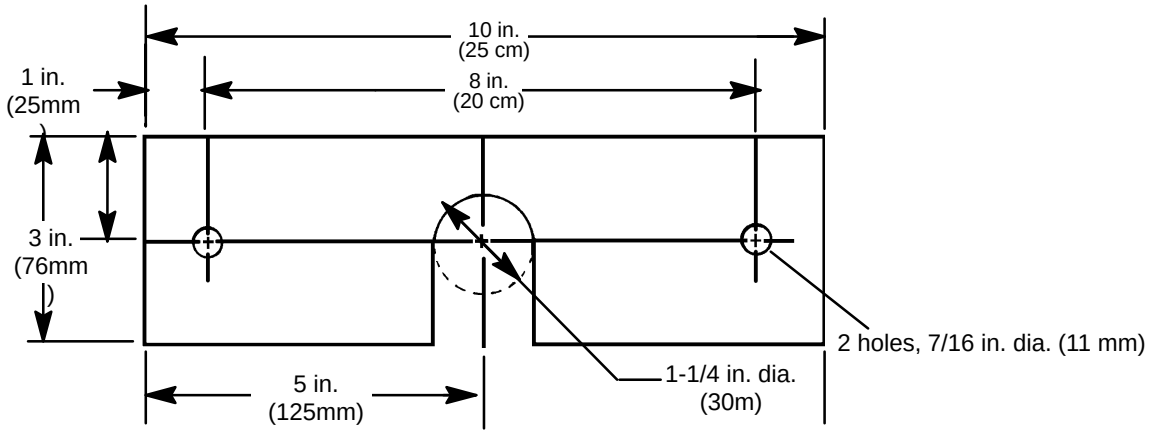
7. Tighten end cap securely using spanner wrench [1/4 in. x 5/16 in. (6.4mm x 8mm) long pegs].

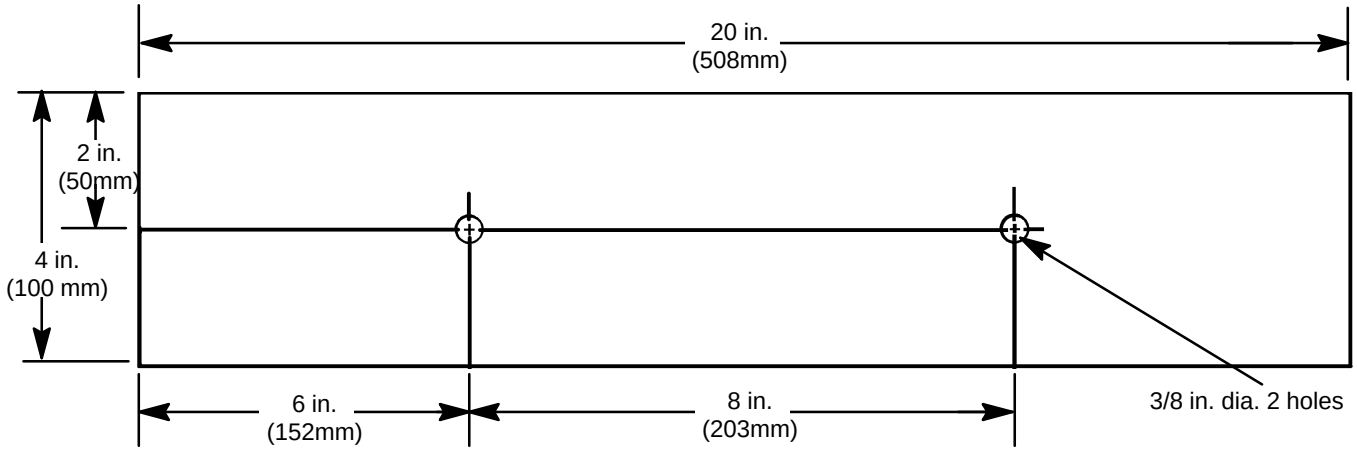


51145

Instructions for Making Retaining Tool





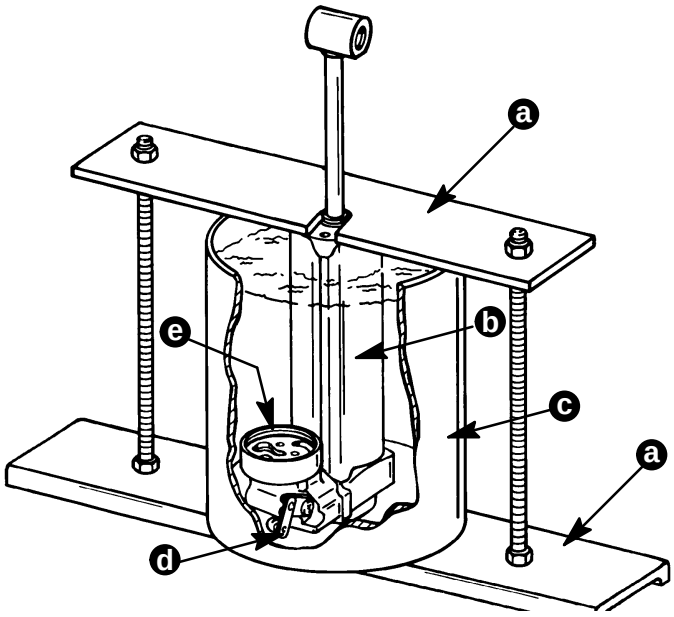


Bleeding Manual Tilt System

IMPORTANT: While bleeding tilt system, time must be allowed between each stroke to allow air bubbles to dissipate.

1. With shock rod in the full up position and manifold cam lever open (facing down), secure tilt system to retaining tool and container. (A No. 10 can or 3 lb. coffee can can be used).
2. Fill container to near full level using Quicksilver Power Trim and Steering Fluid or; (ATF) Type F, FA or Dexron II.

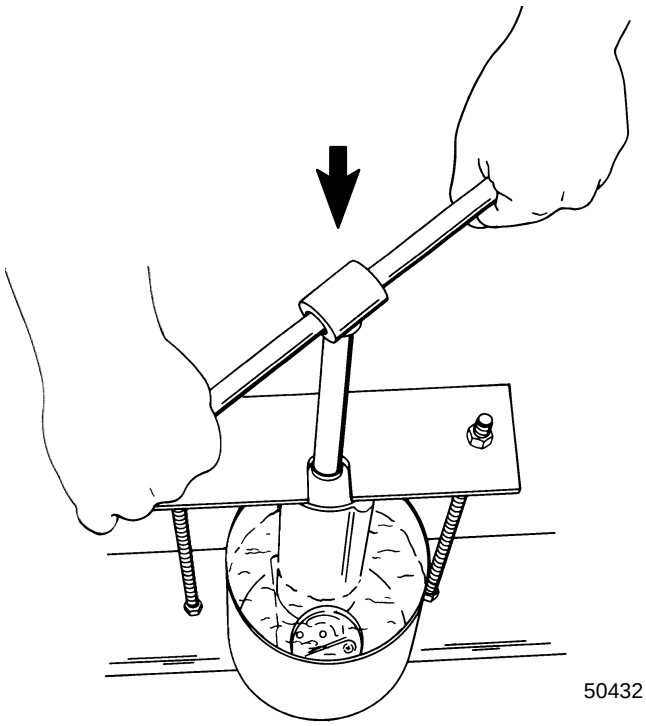
IMPORTANT: Fluid level must remain above accumulator opening during bleeding process.



50447

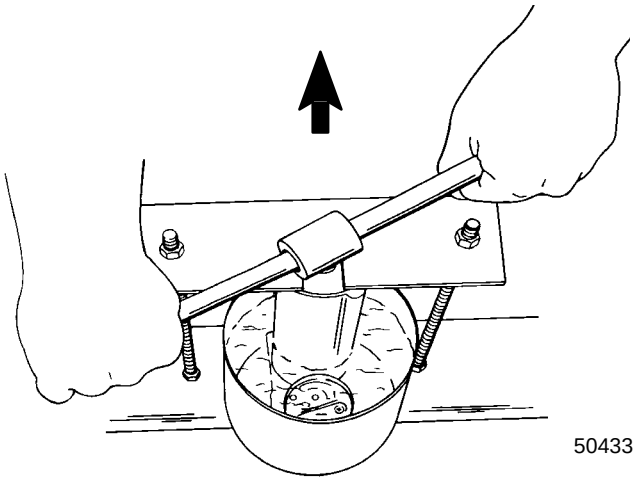
a - Retaining Tool
b - Tilt System
c - Container
d - Cam Lever
e - Accumulator Opening

3. Bleed unit by pushing rod down slowly (18-20 seconds per stroke) until stopped at base. Wait until all air bubbles exit accumulator base.



50432

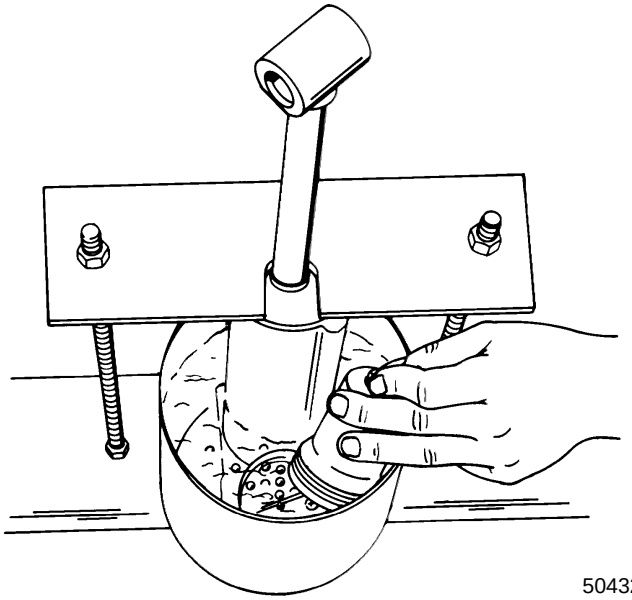
4. During up stroke, pull up on rod slowly 3 in. (76mm) from base.
5. Wait until all air bubbles exit accumulator base.



50433

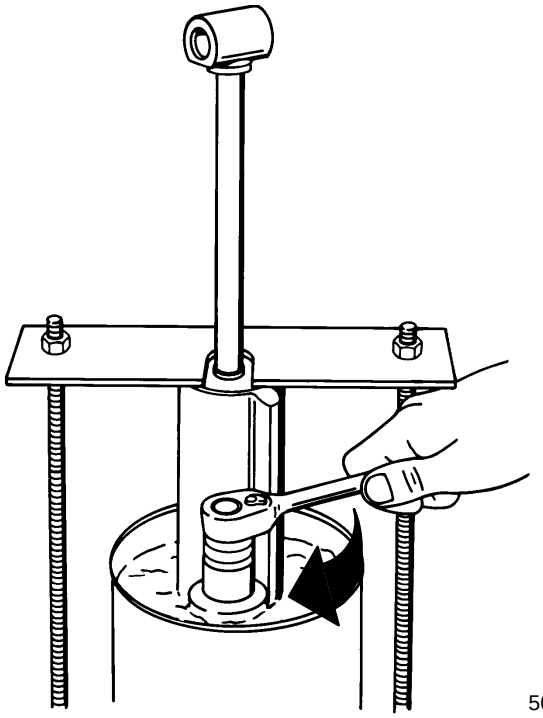
6. Slowly cycle unit 5-8 times (round trip per cycle) using short strokes 3 in. (76mm) from base allowing bubbles to disappear during each stroke.

7. Allow unit to stand five minutes then proceed to cycle unit 2-3 more times using short strokes. No air bubbles should appear from accumulator port at this time.
8. With oil level well above accumulator port, slowly pull rod to full up position.
9. Install accumulator making sure air bubbles do not enter system.



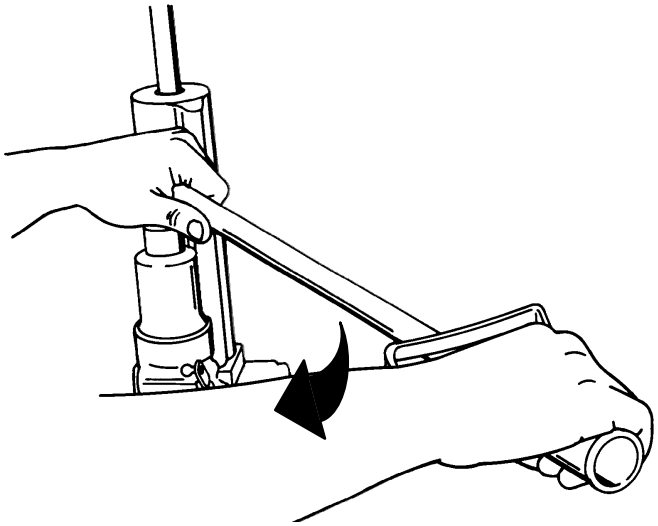
50432

10. Tighten accumulator snugly at this time.



50432

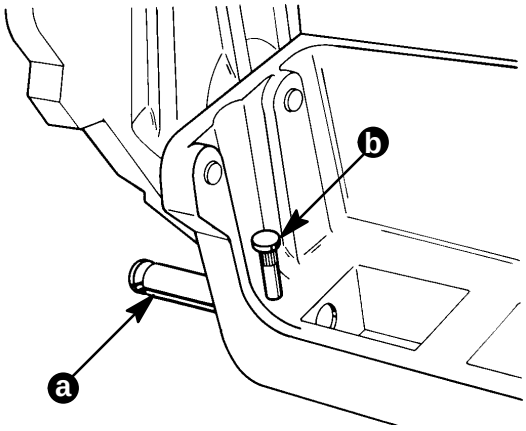
11. With cam lever remaining open (facing down), remove tilt assembly from oil and secure in soft jawed vise. Torque accumulator to 35 lb. ft. (47 N·m).



50433

Manual Tilt System Installation

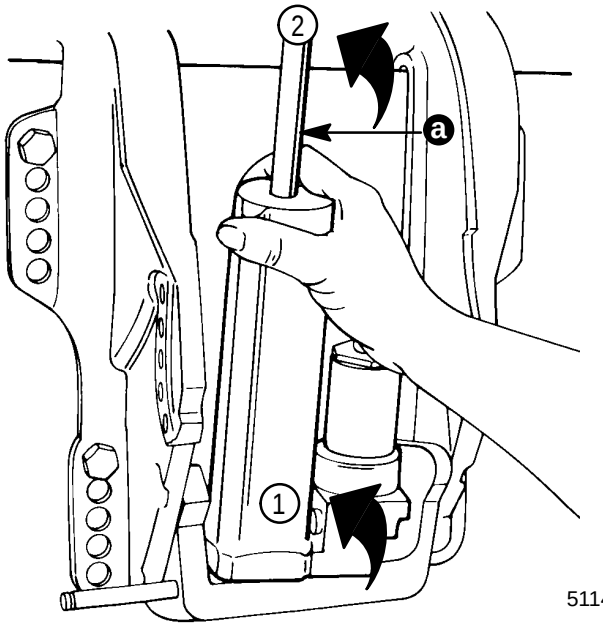
1. Apply Special Lubricant 101 to lower pivot pin hole and pivot pin surface.
2. Start lower pivot pin into pivot pin hole and position lower dowel pin (retained) in its hole.



51148

a - Lower Pivot Pin
b - Lower Dowel Pin

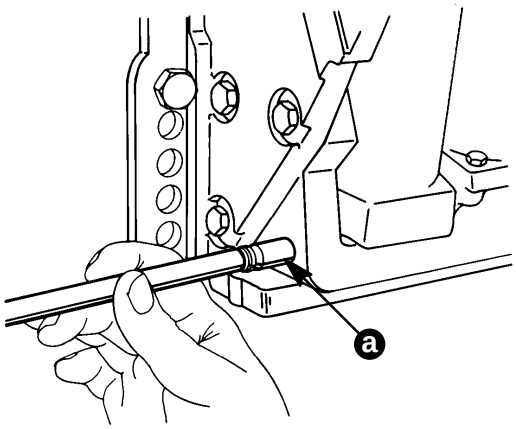
3. Reinstall manual tilt system. Reconnect release valve link rod.



51144

a - Manual Tilt System

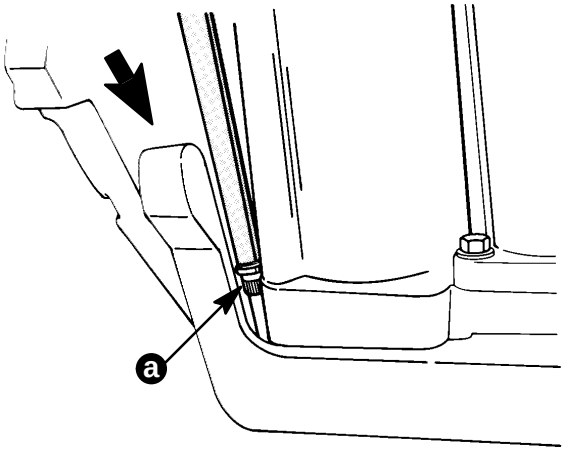
4. Using a suitable punch, drive lower pivot pin into clamp bracket and trim cylinder assembly until pivot pin is flush with outside surface.



51147

a - Lower Pivot Pin

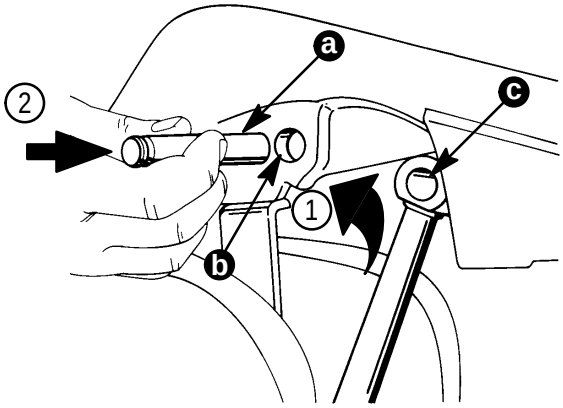
5. Using a punch, drive lower dowel pin in until seated.



51148

a - Lower Dowel Pin

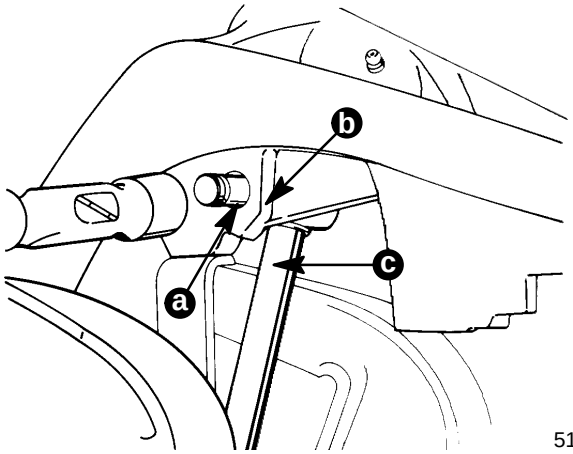
6. Apply 2-4-C w/Teflon Marine Lubricant (92-90018A12) to surface of upper pivot pin, pivot pin hole and shock rod hole.



51148

a - Pivot Pin
b - Pivot Pin Bore
c - Shock Rod Bore

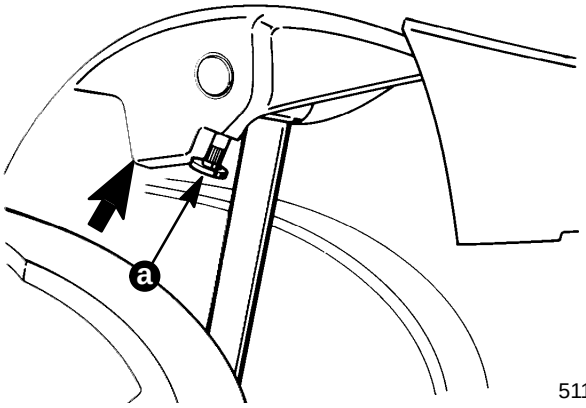
7. Using a mallet, drive upper pivot pin into swivel bracket and through shock rod until pivot pin is flush with swivel bracket.



51148

a - Pivot Pin
b - Swivel Bracket
c - Shock Rod

8. Drive upper dowel pin (a) into its hole until seated.

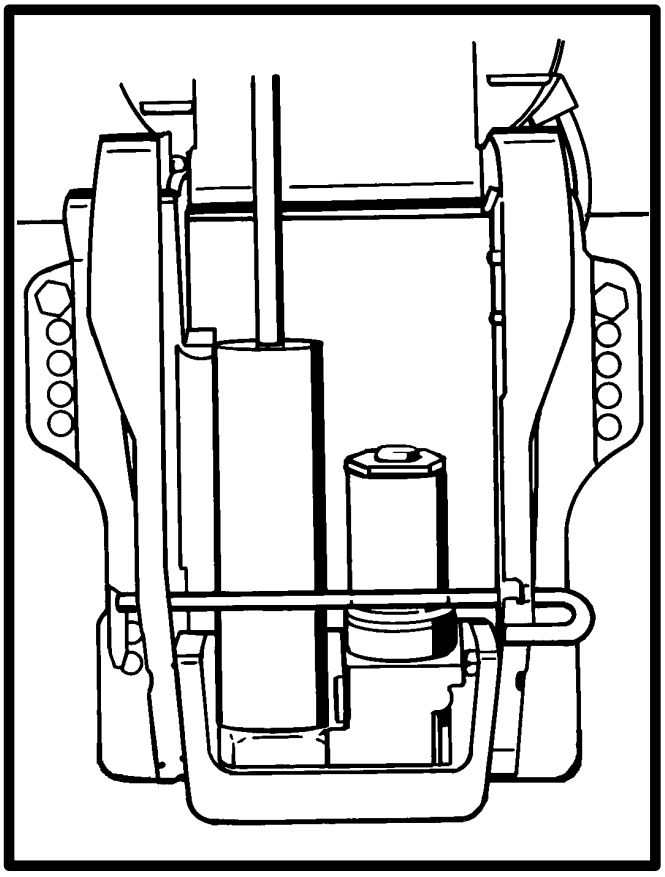


51147

a - Dowel Pin

9. Check manual release cam adjustment. Cam must open and close freely. Adjust link rod as necessary.

MID-SECTION



MANUAL TILT SYSTEM (DESIGN 4)

5

G

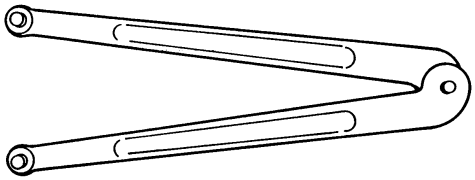
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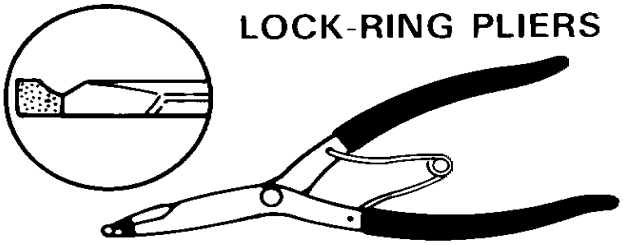
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Special Tools

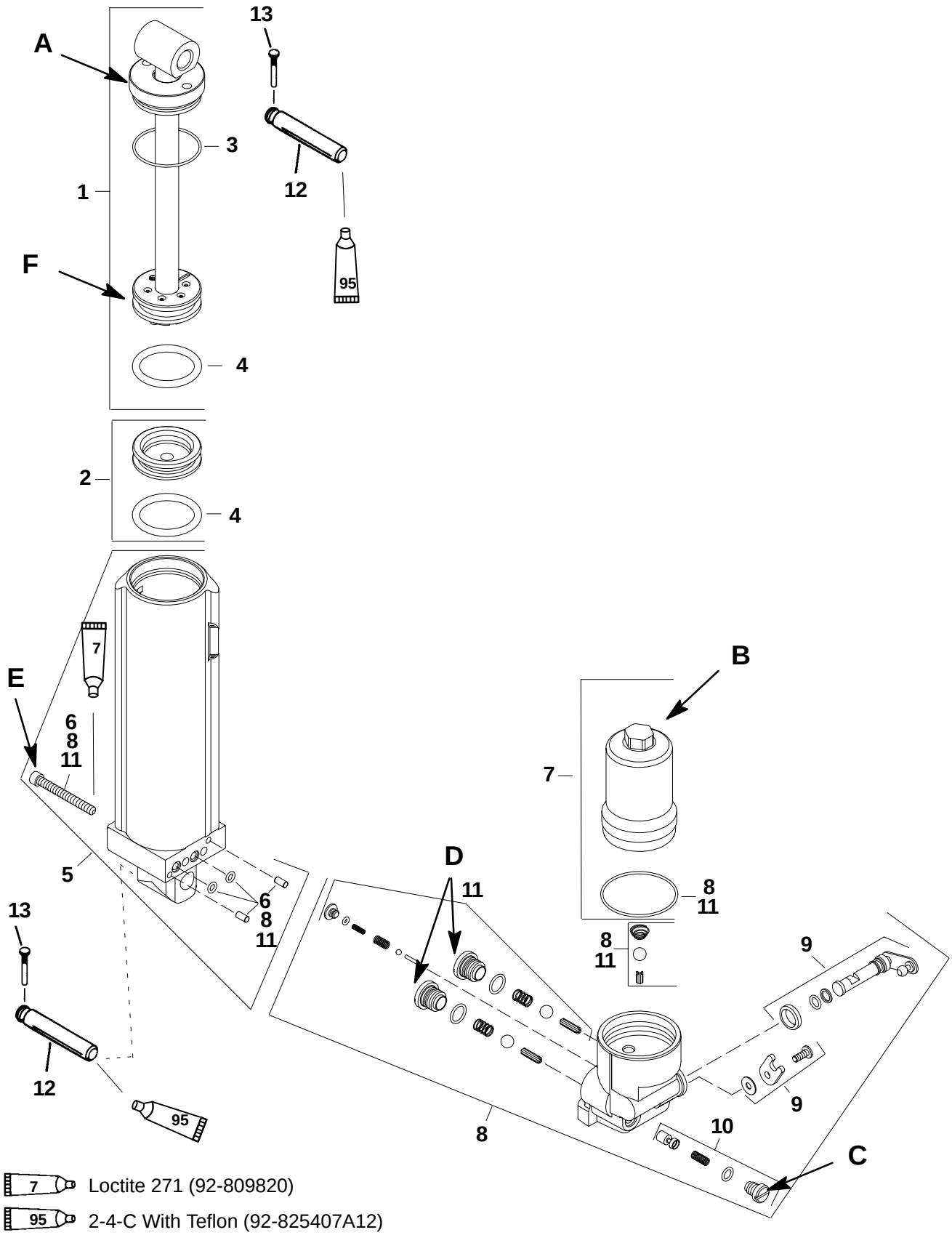
1. Spanner Wrench P/N 91-74951



2. Lock-Ring Pliers P/N 91-822778A3



MANUAL TILT COMPONENTS



7 Loctite 271 (92-809820)

95 2-4-C With Teflon (92-825407A12)

NOTE: *Lubricate all O-rings using Quicksilver Power Trim and Steering Fluid. If not available, use automotive (ATF) automatic transmission fluid.*

NOTE: *It is recommended that all O-rings be replaced when servicing tilt system.*

MANUAL TILT COMPONENTS

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
–	1	MANUAL TRIM ASSEMBLY			
–	1	MANUAL TRIM **BEACHING** ASSEMBLY			
1	1	SHOCK ROD ASSEMBLY		45	61
	1	SHOCK ROD ASSEMBLY **(BEACHING)**			
2	1	MEMORY PISTON ASSEMBLY			
3	1	O RING REBUILD KIT-Cylinder			
4	2	O RING			
5	1	CYLINDER ASSEMBLY			
6	1	SCREW AND SEAL KIT			
7	1	ACCUMULATOR ASSEMBLY		35	47
8	1	VALVE BODY ASSEMBLY			
9	1	CAM KIT			
10	1	VELOCITY VALVE KIT	75		8.5
11	1	CHECK SYSTEM REPAIR KIT	75		8.5
–	1	O RING KIT			
12	2	PIN			
13	2	GROOVE PIN			

A – Torque cylinder cap to 45 lb. ft. (61 N·m)

B – Torque Accumulator to 35 lb. ft. (47 N·m)

C – Torque Velocity Valve to 75 lb. in. (8.5 N·m)

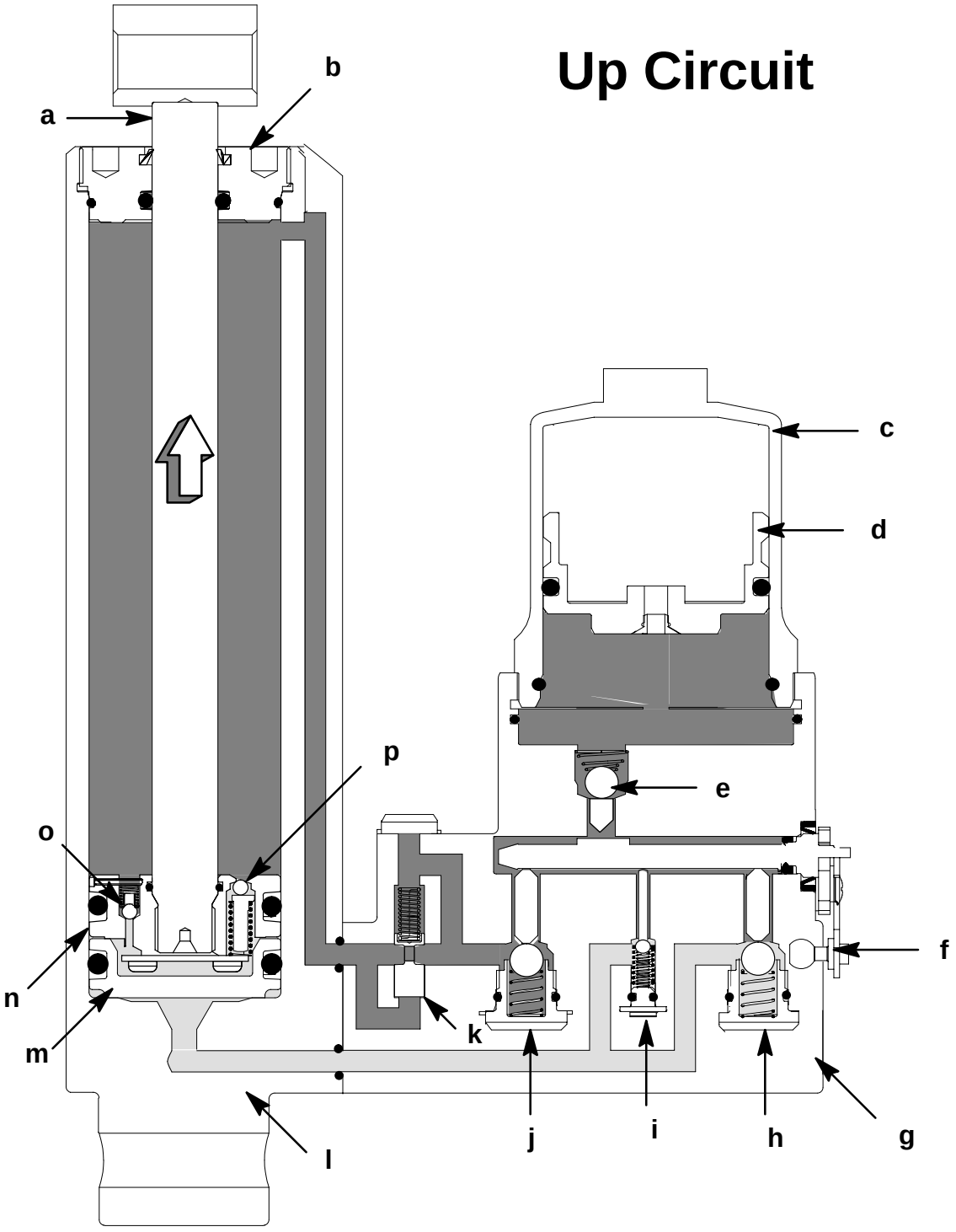
D – Torque Transfer Valve Plug to 75 lb. in. (8.5 N·m)

E – Torque Screw to 100 lb. in. (11 N·m)

F – Torque Shock Piston to 90 lb. ft. (122 N·m)

MANUAL TRIM FLOW DIAGRAMS

Up Circuit



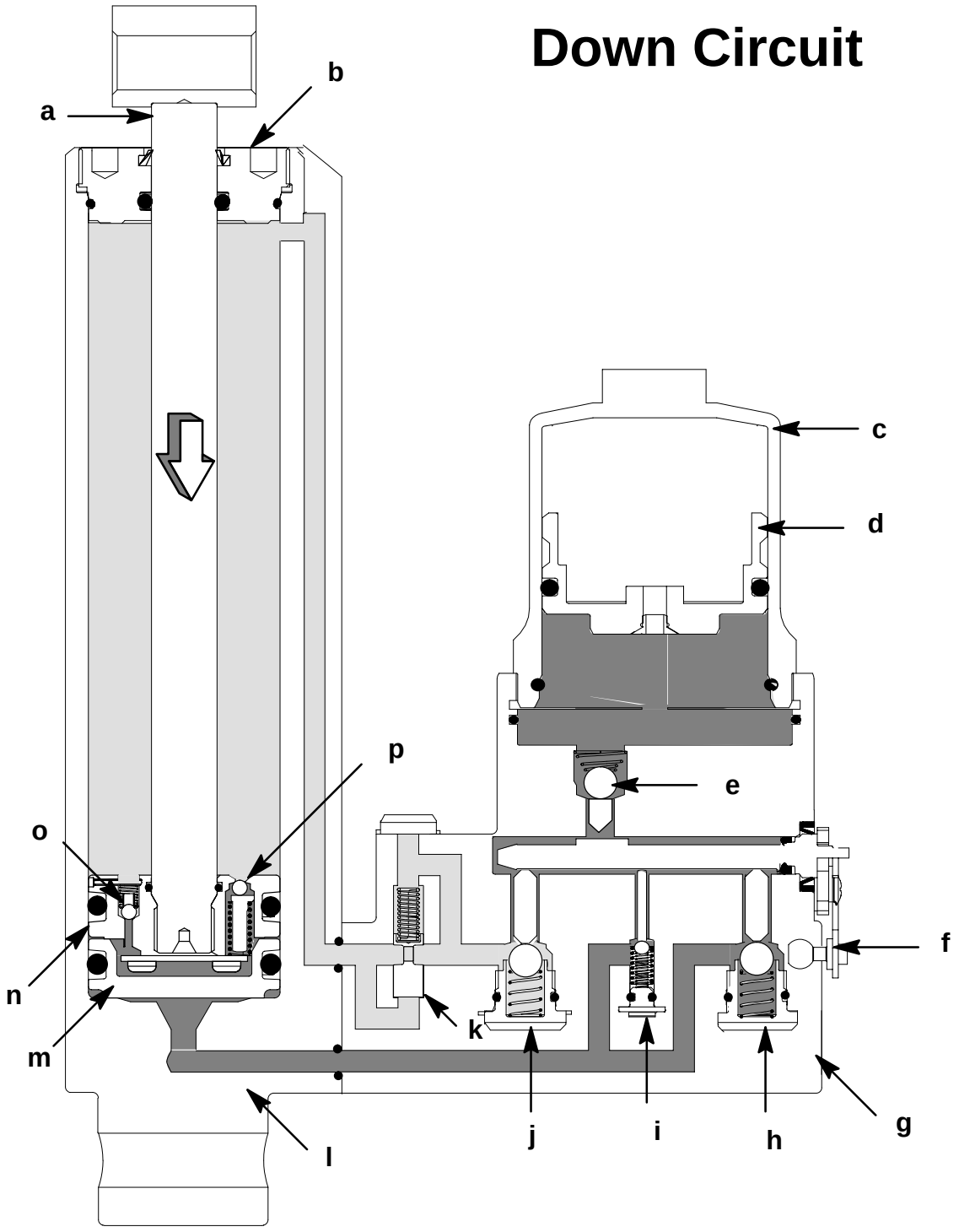
a - Shock Rod
b - End Cap
c - Accumulator
d - Accumulator Piston
e - Accumulator Check Valve
f - Camshaft Lever
g - Manifold
h - Down Fast Transfer Valve

i - Down Slow Transfer Valve
j - Up Fast Transfer Valve
k - Surge Valve
l - Cylinder
m - Memory Piston
n - Shock Piston
o - Shock Return Valve
p - Impact Relief Valve

Tilt Up

With the engine in the down position, the accumulator piston (d) will be at the top of the accumulator (c) with the gas at maximum pressure. To raise the engine, the camshaft lever (f) is rotated all the way down. The internal shaft connected to the camshaft lever will move the push rods, opening the accumulator check valve (e), both fast transfer valves (h & j) and the down slow transfer valve (i). As the operator lifts the engine; oil, under pressure inside the accumulator, will flow around both the slow transfer valve (i) and the down circuit fast transfer valve (h). Oil flows into the bottom of the tilt cylinder forcing the memory piston (m) into the shock piston (n) and then forcing the shock rod (a) up and out. Oil above the shock piston exits the cylinder (l) through an interconnecting passage along side of the cylinder and returns into the manifold (g). Inside the manifold the oil flows past the groove in the surge valve (k), through the transfer valve (j) and mixes with the oil flowing from the accumulator into the up cavity. With the engine in the correct position, the camshaft lever (f) is rotated up and the push rods allow the check valves (e, h, i, & j) to close. The closed check valves prevent the oil from traveling between cavities and locks the engine into position.

Down Circuit



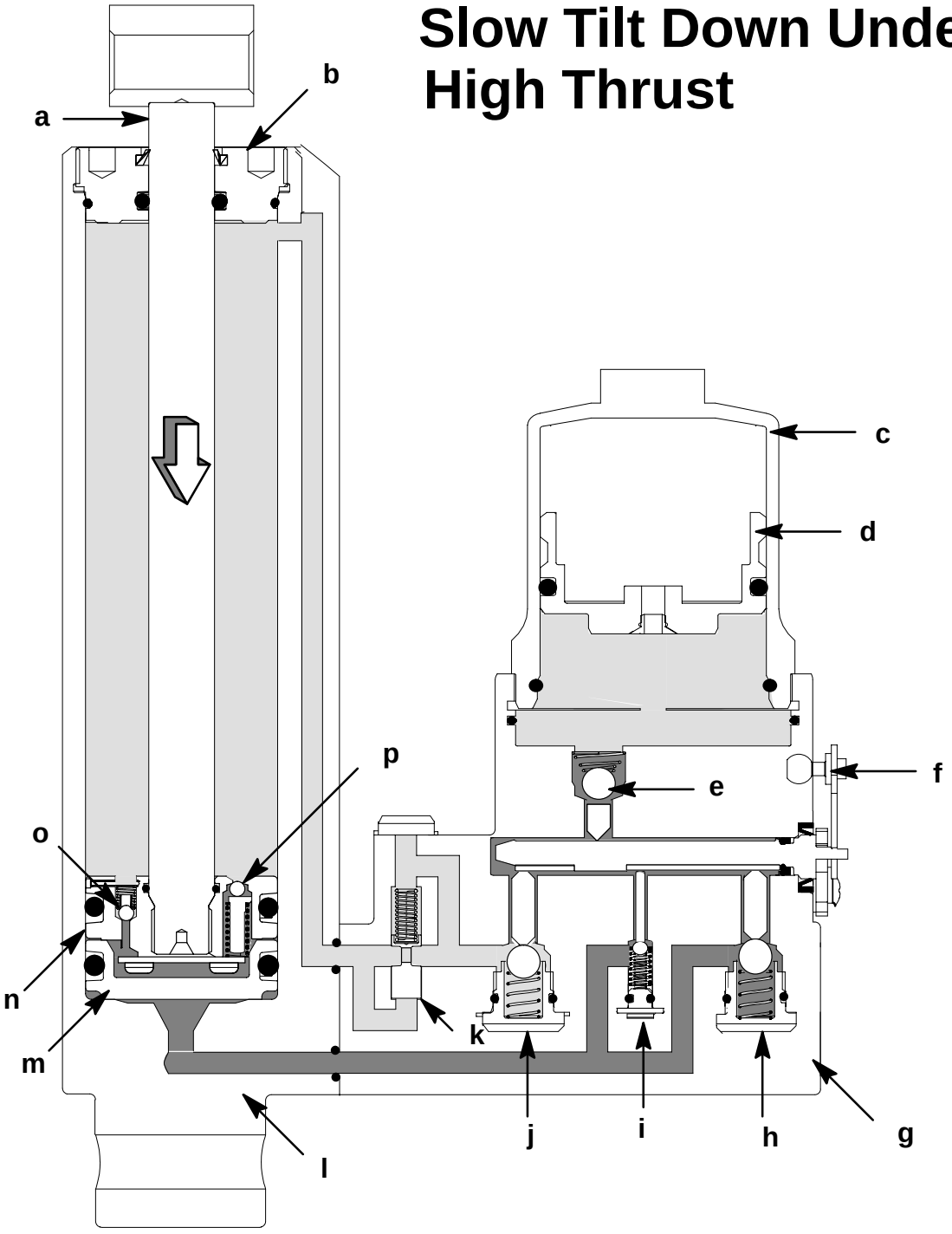
a - Shock Rod
b - End Cap
c - Accumulator
d - Accumulator Piston
e - Accumulator Check Valve
f - Camshaft Lever
g - Manifold
h - Down Fast Transfer Valve

i - Down Slow Transfer Valve
j - Up Fast Transfer Valve
k - Surge Valve
l - Cylinder
m - Memory Piston
n - Shock Piston
o - Shock Return Valve
p - Impact Relief Valve

Tilt Down

With the engine tilted up, the piston inside the accumulator piston (d) will be at the bottom of the accumulator (c) and the gas pressure is low. To lower the engine, the camshaft lever (f) is rotated down, the internal cam will cause the push rods to open the accumulator check valve (e), both fast transfer valves (h & j) and the down slow transfer valve (i). The operator will have to press down on the engine cowl to overcome the pressure inside cylinder. Fluid will flow out of the bottom of the cylinder, past both the down fast transfer valve (h) and down slow transfer valve (i). Fluid will flow past the up fast transfer valve (j), surge valve (k) and through the interconnecting passage into the top of the cylinder (l). Due to the shock rod (a), the tilt cylinder cavities differ in volume, the extra fluid from the up cavity [forced into the accumulator (c)] will cause the internal accumulator piston (d) to compress the gas. With the engine in the correct position, the camshaft lever is rotated up and the push rods allow the check valves (e, h, i, & j) to close.

Slow Tilt Down Under High Thrust



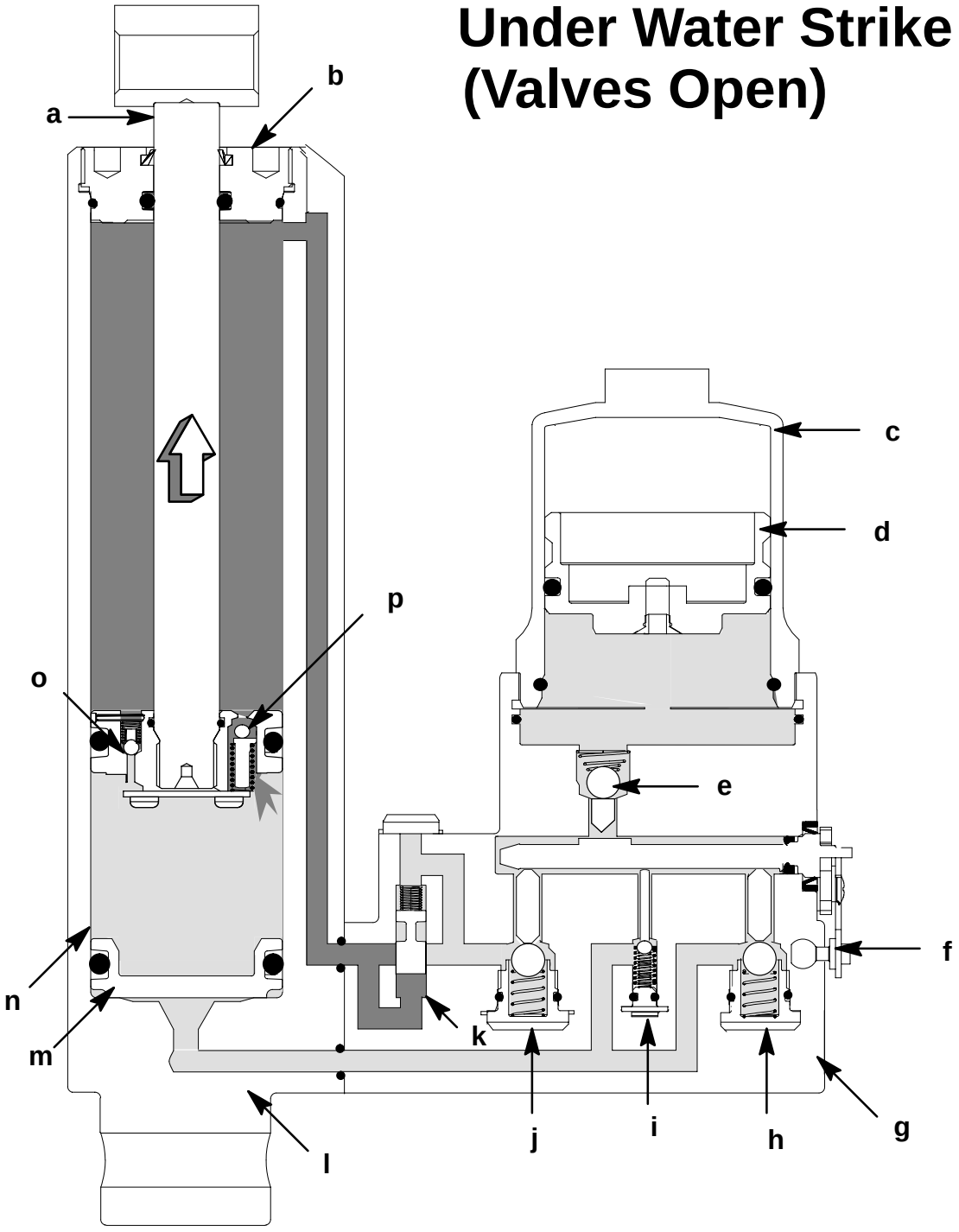
a - Shock Rod
b - End Cap
c - Accumulator
d - Accumulator Piston
e - Accumulator Check Valve
f - Camshaft Lever
g - Manifold
h - Down Fast Transfer Valve

i - Down Slow Transfer Valve
j - Up Fast Transfer Valve
k - Surge Valve
l - Cylinder
m - Memory Piston
n - Shock Piston
o - Shock Return Valve
p - Impact Relief Valve

Slow Tilt Down Under High Thrust

To tilt the engine down under high thrust conditions [where the propeller thrust forces the shock rod down, creating higher pressure below the memory piston (m)] the camshaft lever (f) is rotated slightly downward. The internal shaft connected to the lever will open the down slow transfer valve (i) allowing oil under pressure into the cavity around the shaft. The higher oil pressure will open the up fast transfer valve (j) allowing oil from the bottom of the cylinder to flow above the shock piston (n) while lowering the engine. Additional oil will flow into the accumulator (c) as the internal pressure forces the accumulator check valve (e) to open. Oil flowing into the accumulator moves the accumulator piston (d) and compresses the gas.

Under Water Strike (Valves Open)

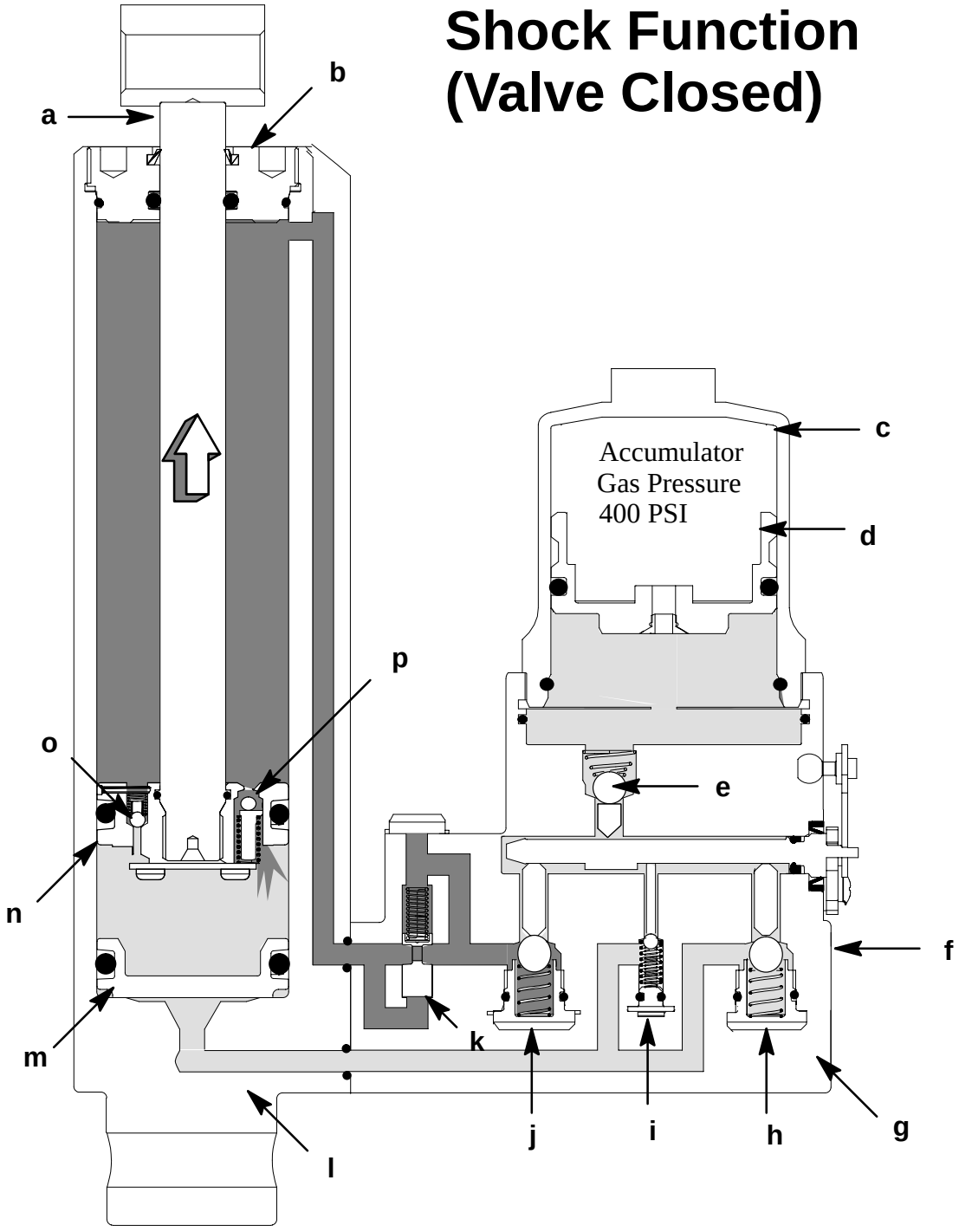


a - Shock Rod
b - End Cap
c - Accumulator
d - Accumulator Piston
e - Accumulator Check Valve
f - Camshaft Lever
g - Manifold
h - Down Fast Transfer Valve
i - Down Slow Transfer Valve
j - Up Fast Transfer Valve
k - Surge Valve
l - Cylinder
m - Memory Piston
n - Shock Piston
o - Shock Return Valve
p - Impact Relief Valve

Under Water Strike With Valves Open

Should the drive unit strike a submerged object while in forward motion, the shock rod (a) will extend from the tilt cylinder (l). Fluid will attempt to exit the cylinder through the interconnecting passage. The rapid fluid flow will increase the pressure below the surge valve (k), causing the valve to move, closing the oil return passage back into the accumulator (c). Oil inside the up cavity is locked in a static position by the closed up fast transfer valve (j), the closed down slow transfer valve (i) and down fast transfer valve (h). As the shock rod extends outward, the pressure inside the up cavity will reach sufficient pressure to open the shock valve (p) which opens at 880-1110 psi. Oil will flow into the cavity created as the shock rod & shock piston (a & n) moves away from the memory piston (m).

Shock Function (Valve Closed)



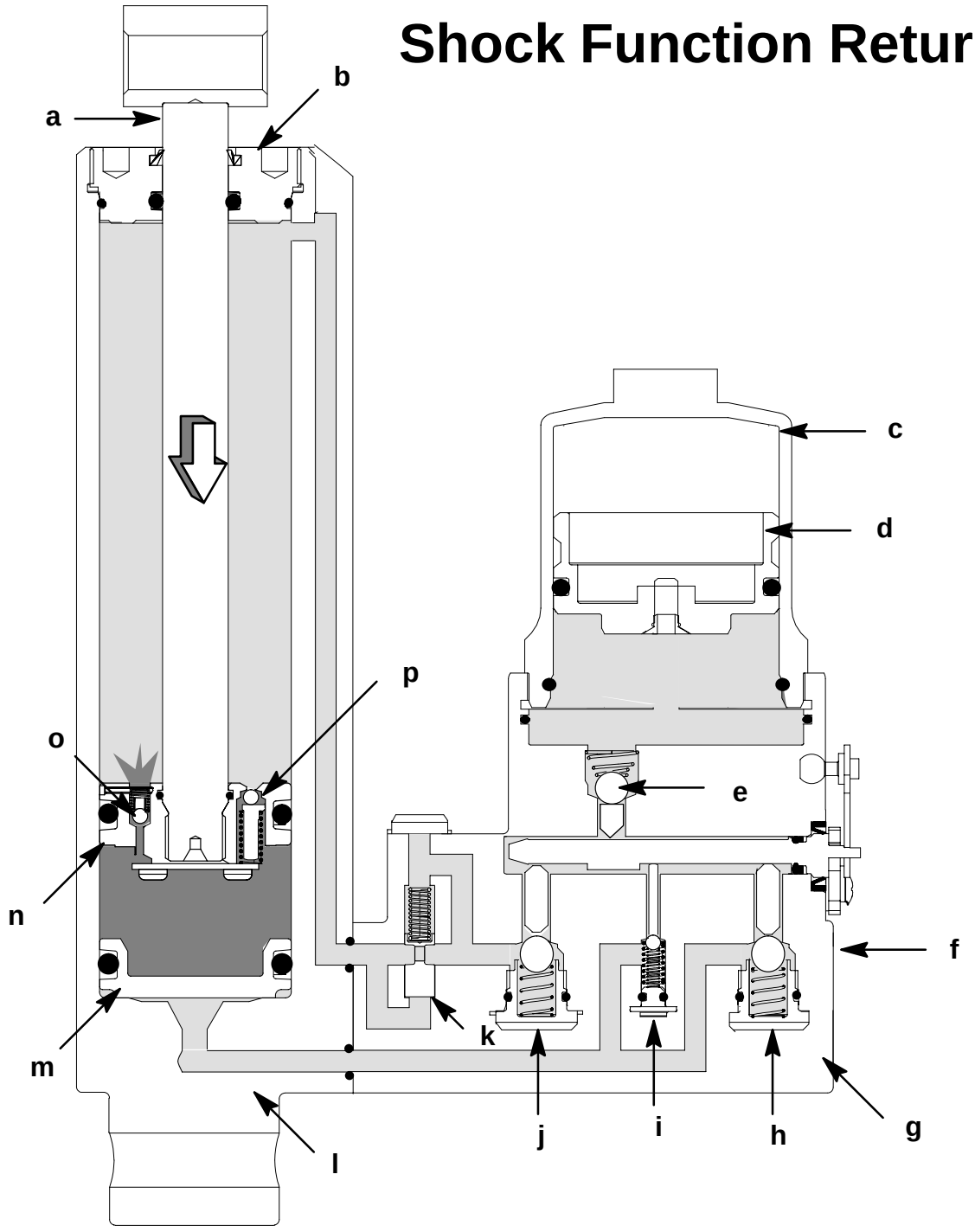
a - Shock Rod
b - End Cap
c - Accumulator
d - Accumulator Piston
e - Accumulator Check Valve
f - Camshaft Lever
g - Manifold
h - Down Fast Transfer Valve

i - Down Slow Transfer Valve
j - Up Fast Transfer Valve
k - Surge Valve
l - Cylinder
m - Memory Piston
n - Shock Piston
o - Shock Return Valve
p - Impact Relief Valve

Shock Function With Valves Closed

Should the drive unit strike a submerged object while in forward motion, the shock rod (a) will extend from the cylinder (l). Oil inside the up cavity is locked in a static position by the closed up fast transfer valve (j), the closed down slow transfer valve (i) and closed down fast transfer valve (h). Fluid will attempt to exit the cylinder through the interconnecting passage back into the accumulator (c). The closed up fast transfer valve (j) will prevent the fluid return. As the shock rod extends outward, the pressure inside the up cavity will reach sufficient pressure to open the shock valve (p) which opens at 880-1110 psi. Oil will flow into the cavity created as the shock rod & shock piston (a & n) moves away from the memory piston (m).

Shock Function Return



a - Shock Rod
b - End Cap
c - Accumulator
d - Accumulator Piston
e - Accumulator Check Valve
f - Camshaft Lever
g - Manifold
h - Down Fast Transfer Valve
i - Down Slow Transfer Valve
j - Up Fast Transfer Valve
k - Surge Valve
l - Cylinder
m - Memory Piston
n - Shock Piston
o - Shock Return Valve
p - Impact Relief Valve

Shock Function Return

After the drive clears the object, the shock return valve (o) will allow the oil to flow from between the shock piston (n) and memory piston (m) onto the down cavity as the drive returns to its original running position.

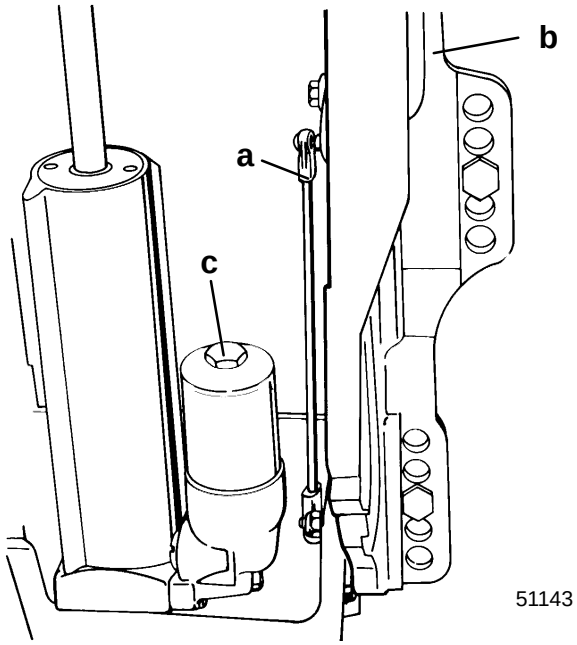
Hydraulic System Troubleshooting

Refer to disassembly/reassembly instructions (following) if disassembly is required when servicing.

IMPORTANT: After debris or failed components have been found (during troubleshooting procedure), it is recommended that unit be disassembled completely and ALL O-rings be replaced. Check ball components and castings must be cleaned using engine cleaner and compressed air or replaced prior to reassembly.

Support outboard with tilt lock lever when servicing manual tilt system.

1. Check manual release cam adjustment. Cam must open and close freely. Adjust cam link rod as necessary.



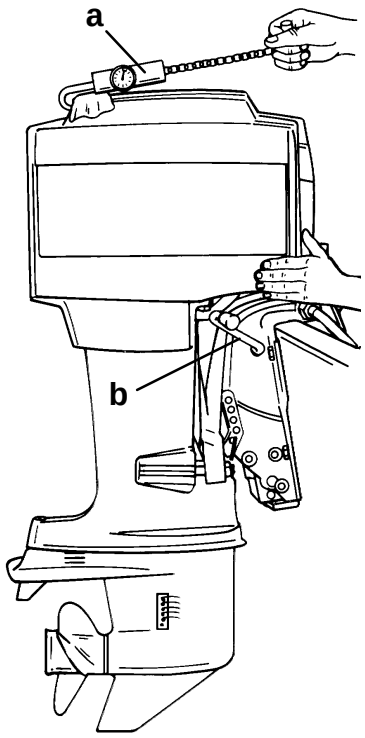
51143

a - Link Rod
b - Manual Release Lever
c - Accumulator

2. Check for external leaks in the manual tilt system. Replace defective part(s) if leak is found.

IMPORTANT: If cut or damaged O-rings are found, inspect machined surfaces for scoring, burrs or debris.

3. Check for discharged accumulator. 35 to 50 lb. ft. (47-68 N·m) of pulling force must be attained when tilting outboard from full “down” to full“up” position. If more than 50 lb. ft. (68 N·m) of force is required, replace accumulator.



50431

a - Weight Scale
b - Valve Lever (open position)

Manual Tilt System Removal

⚠ CAUTION

Remove cowling and remove all spark plug leads from spark plugs to prevent accidental starting while servicing outboard.

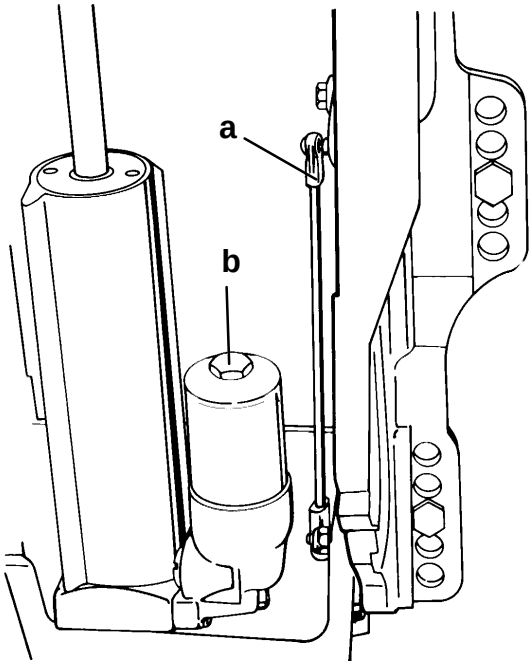
⚠ WARNING

Service or installation of the tilt system may result in loss of pressure in the shock cylinder. If the outboard is not in the full down position, such loss of pressure will cause the engine to fall to the full down position with a potential for damaging engine or causing personal injury. To avoid such injury support outboard in the up position using tilt lock lever.

⚠ WARNING

Manual tilt system is pressurized. Accumulator must be removed when shock rod is in the full up position, prior to servicing, otherwise oil spray-back may occur.

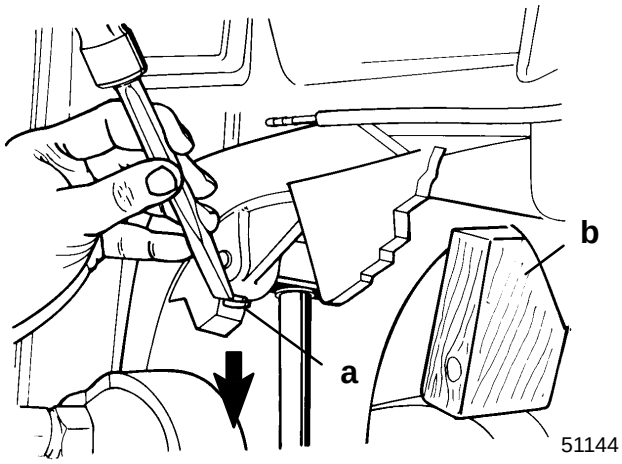
1. Support outboard in the up position using tilt lock lever.
2. Remove link rod.



51143

a - Link Rod
b - Accumulator

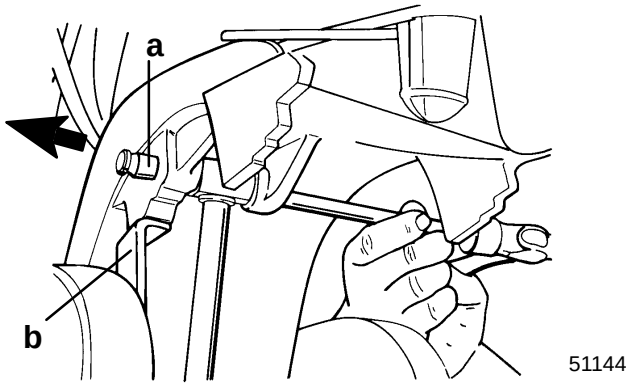
3. Position piece of wood under transom bracket instead of tilt lock for access of removing pin. Use suitable punch to remove (DRIVE DOWN) upper dowel pin. Retain dowel pin.



51144

a - Dowel Pin
b - Wood

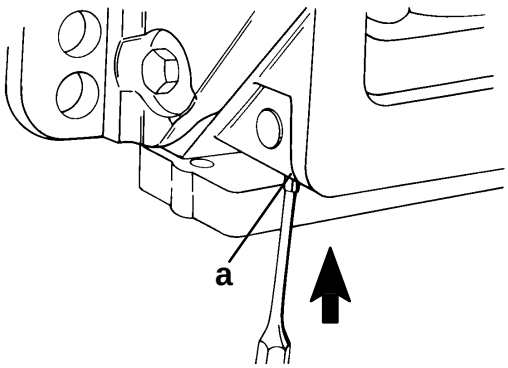
4. Position tilt lock and remove piece of wood. Use suitable punch to drive out upper pivot pin.



51144

a - Pivot Pin
b - Tilt Lock

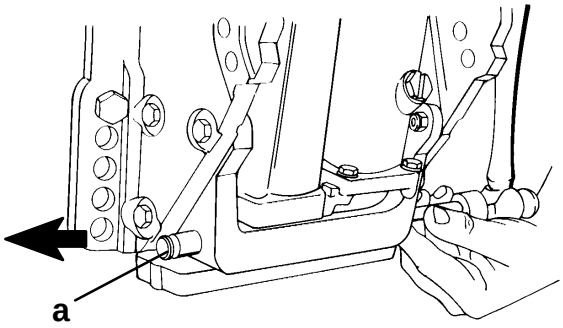
5. Use punch to remove (DRIVE UP) lower dowel pin. Retain dowel pin.



51144

a - Dowel Pin

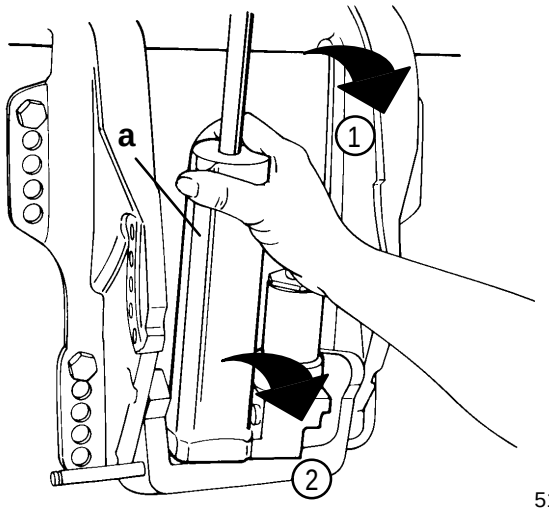
6. Use suitable punch to drive out lower pivot pin.



51144

a - Pivot Pin

7. Tilt shock absorber assembly (TOP FIRST) out from clamp bracket and remove assembly.



51144

a - Manual Tilt System

Manual Tilt System Disassembly

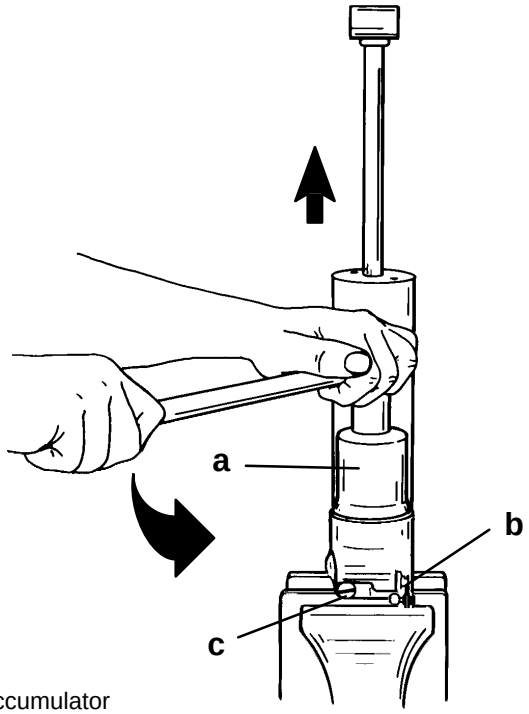
NOTE: *Accumulator contains a high pressure nitrogen charge and is NOT SERVICEABLE. Replace if necessary.*

⚠ WARNING

This tilt system is pressurized. Remove accumulator only when shock rod is in full up position.

Accumulator Removal

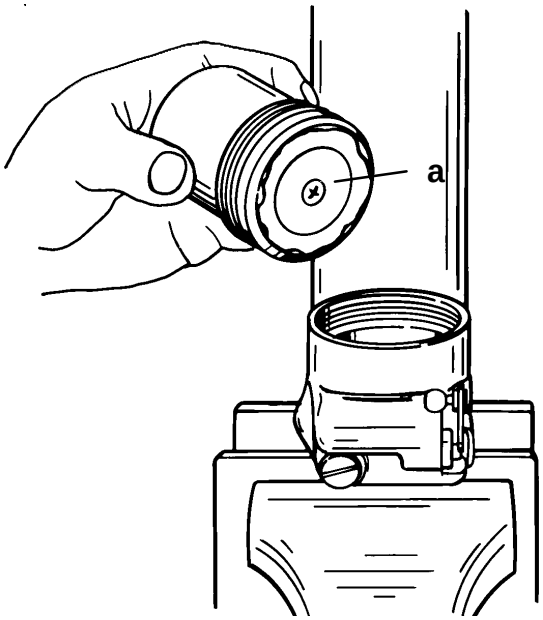
1. Place manual tilt system in soft jawed vise.
2. Position shock rod to full up position.
3. Open cam shaft valve (Down Position).
4. Loosen surge valve enough to drip, wait until dripping stops.
5. When fluid stops dripping, loosen and remove accumulator.



51143

a - Accumulator
b - Cam Lever
c - Velocity Plug

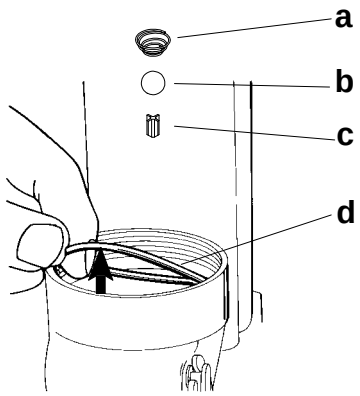
6. If plunger can be compressed into accumulator by hand, accumulator is defective. Replace accumulator.



51143

a - Plunger

7. Once accumulator is removed, remove O-ring, conical spring, steel ball and plunger.

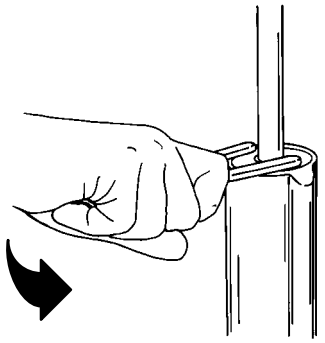


51145

a - Conical Spring
b - Steel Ball
c - Plunger
d - O-ring

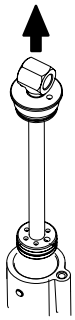
Shock Rod Removal

1. Unscrew cylinder end cap assembly using spanner wrench [1/4 in. x 5/16 in. long pegs].



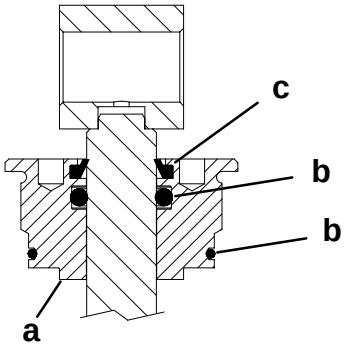
51145

2. Remove shock rod assembly from cylinder.



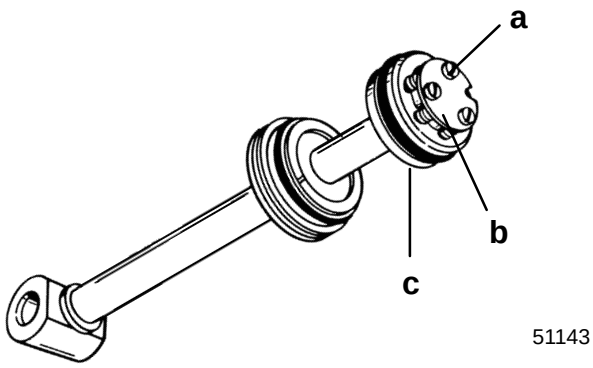
Shock Rod Disassembly

NOTE: *The only serviceable items on the shock rod assembly are the O-rings and wiper ring. If shock rod requires any other repair, replace shock rod assembly.*



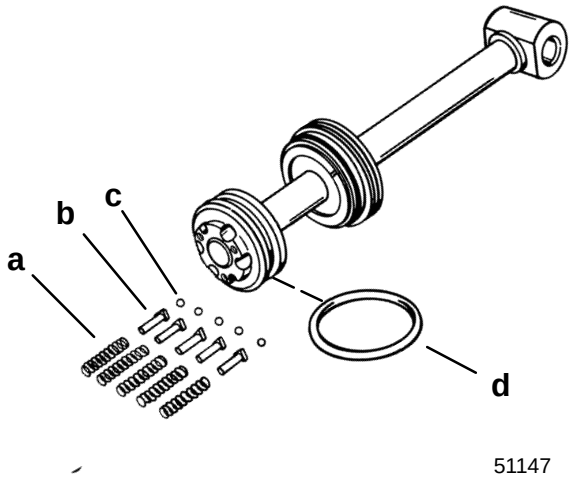
a - End Cap
b - O-rings (2)
c - Wiper Ring

1. Place shock rod assembly on clean work surface.
2. Remove three (3) screws and remove plate from shock rod piston.



a - Screw (3)
b - Plate
c - Shock Rod Piston

3. Remove check ball components from shock rod piston.
4. Remove O-ring.

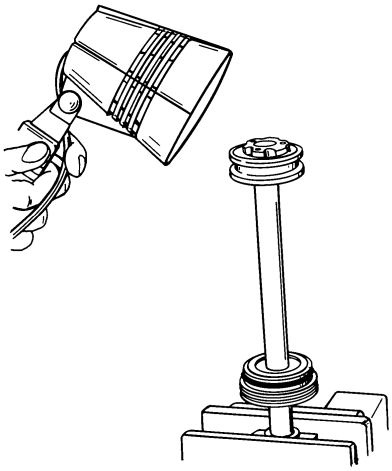


a - Springs (5)
b - Seats (5)
c - Balls (5)
d - O-ring

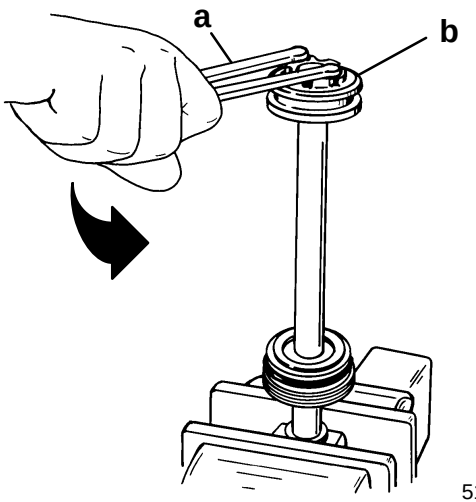
⚠ CAUTION

When removing shock piston, spanner wrench must have 1/4 in. x 5/16 in. long pegs to avoid damage to shock piston.

5. Place shock rod in soft jawed vise and apply heat to loosen piston using torch lamp (P/N 91-63209).
6. Loosen shock rod piston using spanner wrench [1/4 in. x 5/16 in. (6.4mm x 8mm) long pegs].
7. Allow shock rod piston to cool. Remove from shock rod.



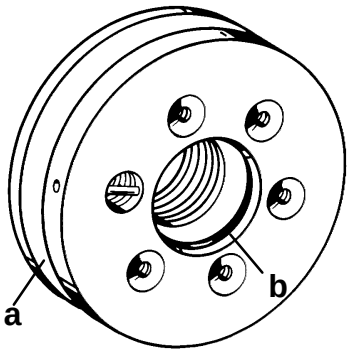
51146



51146

a - Spanner Wrench
b - Shock Rod Piston

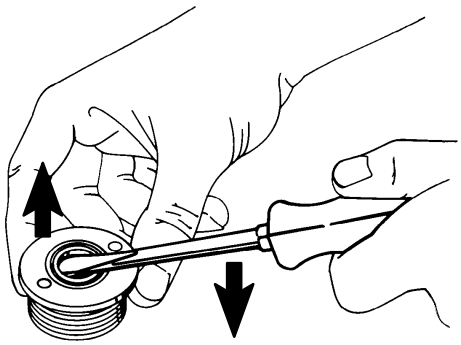
8. Inspect check valve for debris; clean debris from check valve if found. If debris cannot be cleaned from check valve, replace shock piston as an assembly.
9. Clean shock and components with compressed air.
10. Remove inner O-ring.



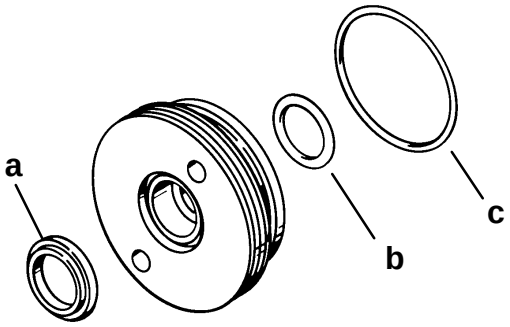
51199

a - Shock Piston
b - O-ring

11. Remove cylinder end cap assembly from shock rod.
12. Inspect shock. If wiper (located in cap) has failed to keep rod clean, replace wiper.
13. Place end cap on clean work surface.
14. Remove rod wiper, inner O-ring, and outer O-ring.



51147

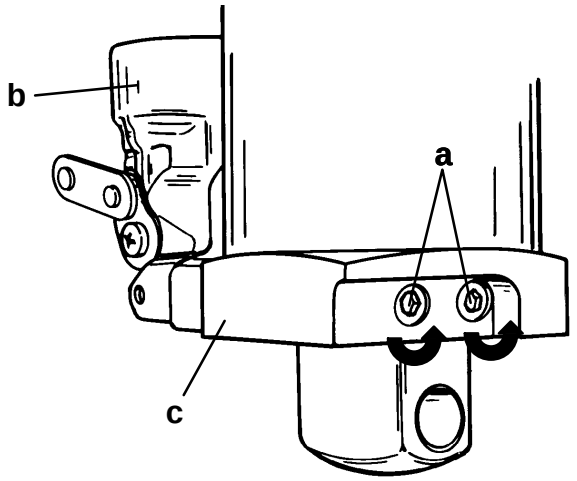


51145

a - Rod Wiper
b - Inner O-ring
c - Outer O-ring

Valve Block Removal

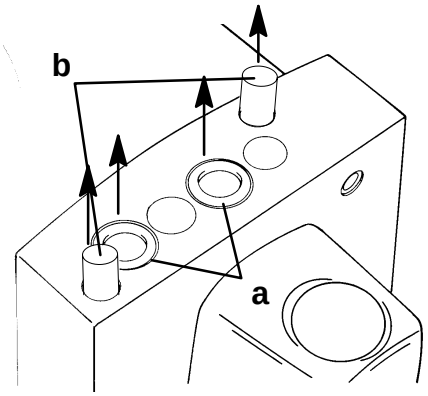
1. Remove two screws from the shock rod cylinder to separate the valve block.



51146

a - Screws (2)
b - Valve Block
c - Shock Rod Cylinder

2. Remove O-rings and dowel pins.

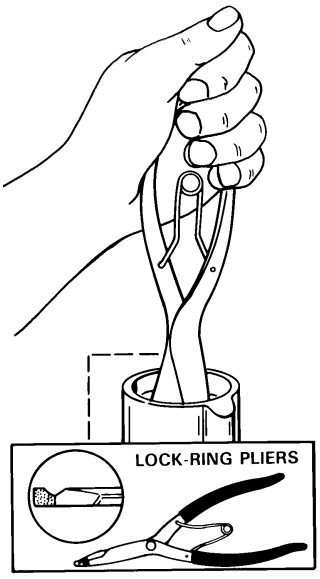


51148

a - O-ring (2)
b - Dowel Pin (2)

Memory Piston Removal

1. Remove memory piston from cylinder using one of two methods:
   a. Using lock ring pliers (Craftsman P/N 4735) or (Snap-on P/N SRP4).



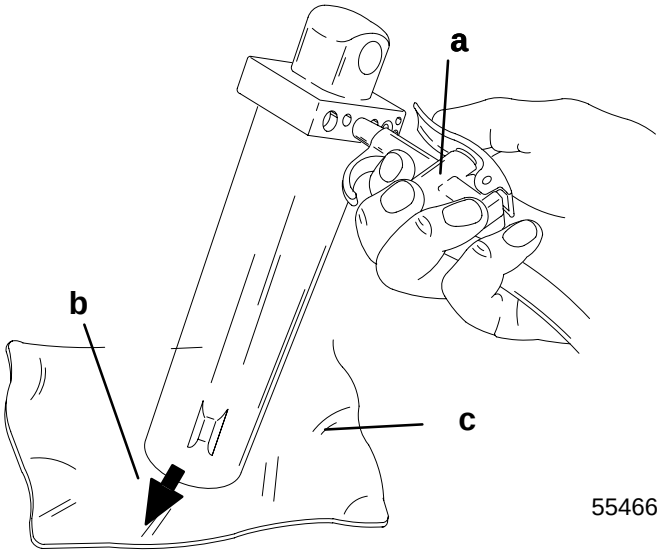
51144

   b. Blowing compressed air into center O-ring hole.

⚠ WARNING

Memory piston cup may be expelled at a high velocity when air pressure is applied. Failure to place cylinder as shown below could result in personal injury.

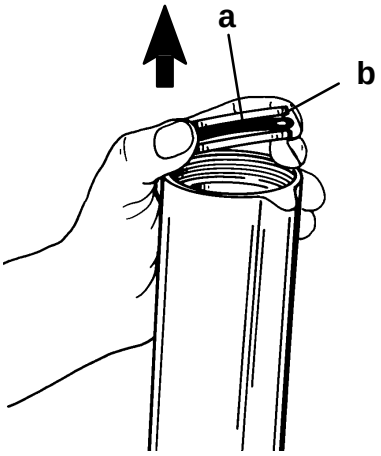
NOTE: *Point cylinder opening down and away. Use a shop rag or towel to avoid damage to the memory piston. Fluid will blow out also.*



55466

a - Adaptor/Air Hose
b - Memory Piston Exit
c - Shop Rag

2. Remove O-ring from memory piston.

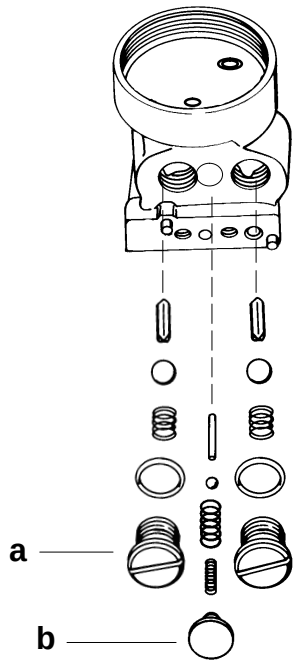


51144

a - O-Ring
b - Memory Piston

Valve Block Disassembly

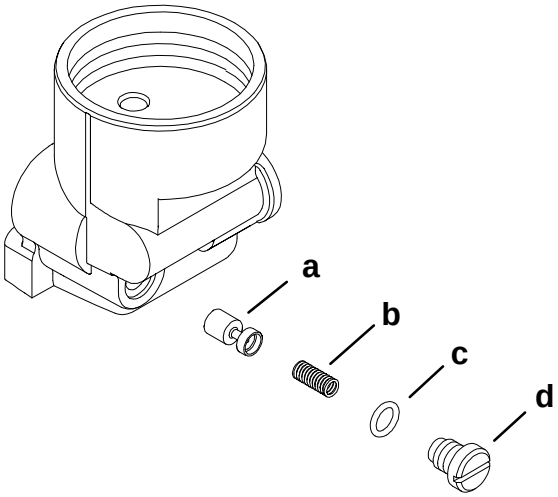
1. Remove check retainer plug and components.
2. Remove hydraulic oil transfer valve plugs and components.



51142

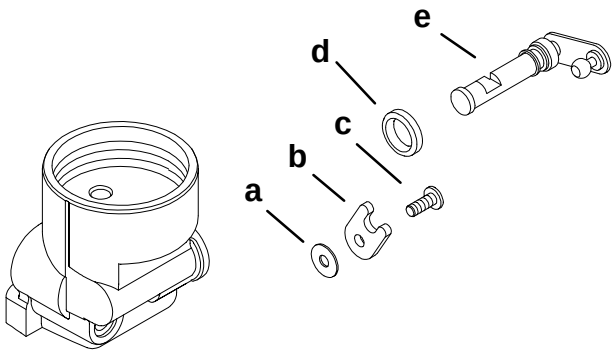
a - Transfer Valve Plug Assembly (2)
b - Check Retainer Plug or Screw Assembly

3. Remove surge valve assembly.



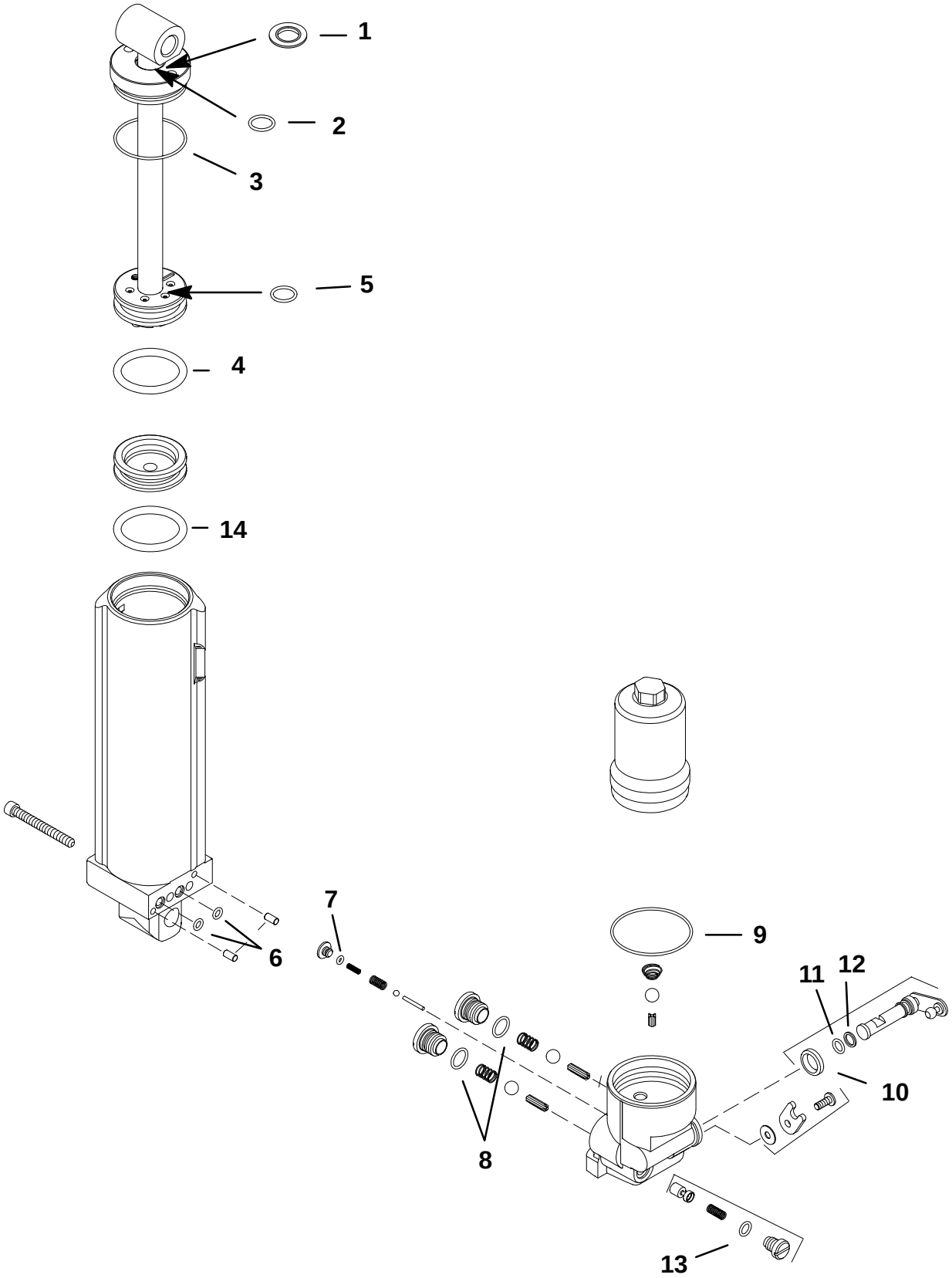
a - Spool
b - Spring
c - O-ring
d - Screw Plug

4. Remove screw and remove cam assembly.



a - Spacer Retainer Clip
b - Retainer Clip
c - Screw
d - Shaft Seal
e - Cam

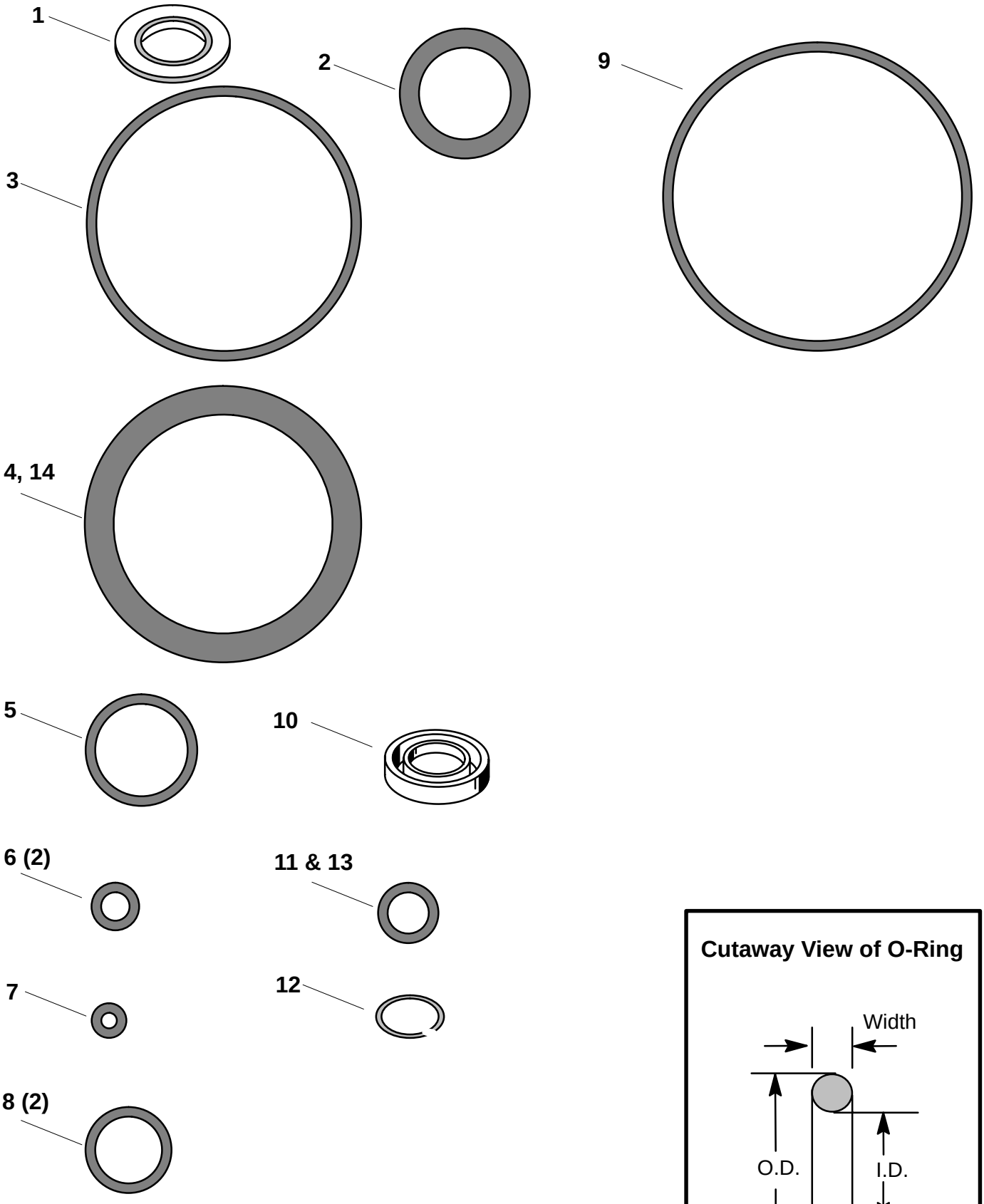
REASSEMBLY - O-RING AND SEAL PLACEMENT



NOTE: *Lubricate all O-rings using Quicksilver Power Trim and Steering Fluid. If not available, use automotive (ATF) automatic transmission fluid.*

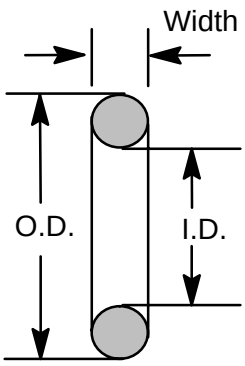
NOTE: *It is recommended that all O-rings be replaced when servicing tilt system.*

Actual O-ring Sizes



O-RINGS SHOWN ARE ACTUAL SIZE

Cutaway View of O-Ring



O-ring Description and Sizes

O-Ring	Description	O-Ring I.D.	O-Ring O.D.	O-Ring Width
1	Wiper Ring			
2	Cyl. Cap, Inner	0.671 in. (17.04 mm)	0.949 in. (24.10 mm)	0.139 in. (3.53 mm)
3	Cyl. Cap	1.864 in. (47.34 mm)	2.004 in. (50.90 mm)	0.07 in. (1.78 mm)
4	Shock Piston	1.6 in. (40.64 mm)	2.02 in. (53.086 mm)	0.21 in. (5.334 mm)
5	Piston Bolt	0.676 in. (17.17 mm)	.816 in. (20.726 mm)	0.07 in. (1.78 mm)
6 (2)	Manifold Split Line	0.208 in. (5.283 mm)	0.348 in. (8.839 mm)	0.07 in. (1.78 mm)
7	Slow Valve	0.114 in. (2.90 mm)	0.254 in. (6.451 mm)	0.07 in. (1.78 mm)
8 (2)	Plug	0.489 in. (12.42 mm)	0.629 in. (15.97 mm)	0.07 in. (1.78 mm)
9	Accumulator	2.114 in. (53.69 mm)	2.254 in. (57.25 mm)	0.07 in. (1.78 mm)
10	Lip Seal			
11	Cam Shaft	0.301 in. (7.645 mm)	0.441 in. (11.20 mm)	0.07 in. (1.78 mm)
12	Back Up Ring			
13	Surge Valve	0.301 in. (7.645 mm)	0.441 in. (11.20 mm)	0.07 in. (1.78 mm)
14	Memory Piston	1.6 in. (40.64 mm)	2.02 in. (53.086 mm)	0.21 in. (5.334 mm)

Manual Tilt System Cleaning and Inspection

1. It is recommended that all O-rings exposed during disassembly be replaced.
2. Clean components, filter, and check valve seats using engine cleaner and compressed air. Do not use cloth rags.
3. Inspect all machined surfaces for burrs or scoring to assure O-ring longevity.
4. Inspect shock rod. If wiper (located in cap) has failed to keep rod clean, replace wiper.

Manual Tilt System Reassembly

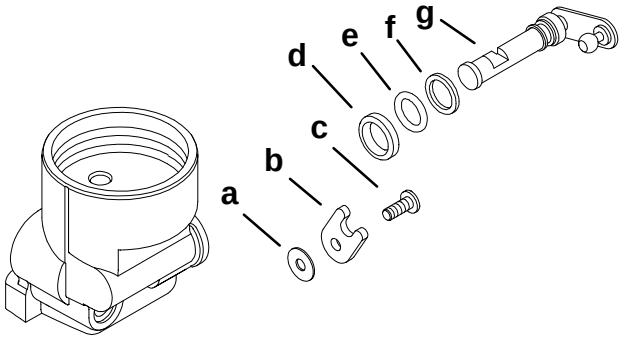
IMPORTANT: Components must be dirt and lint free. Slightest amount of debris in tilt system could cause system to malfunction.

Apply Quicksilver Power Trim and Steering Fluid to all O-rings during reassembly. If not available, use automotive (ATF) automatic transmission fluid.

CAM SHAFT REASSEMBLY

IMPORTANT: Cam shaft O-ring must be lubricated using 2-4-C with Teflon (92-825407A12).

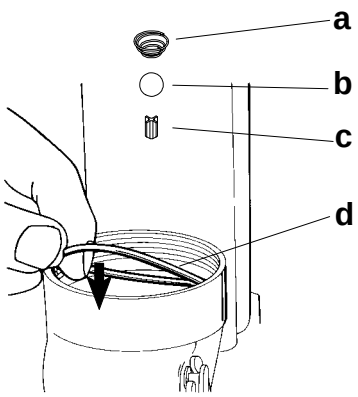
1. Install lubricated O-ring and back up seal to cam.
2. Install shaft seal in valve block with lips facing out.
3. Install cam shaft assembly in valve block.
4. Secure cam shaft in place using insulator, retainer plate, and screw. Tighten screw securely.



a - Spacer Retainer Clip
b - Retainer Clip
c - Screw
d - Shaft Seal
e - O-ring
f - Back up Seal
g - Cam

VALVE BODY CHECK REASSEMBLY

1. Install lubricated O-ring, plunger, steel ball and conical spring to valve block.

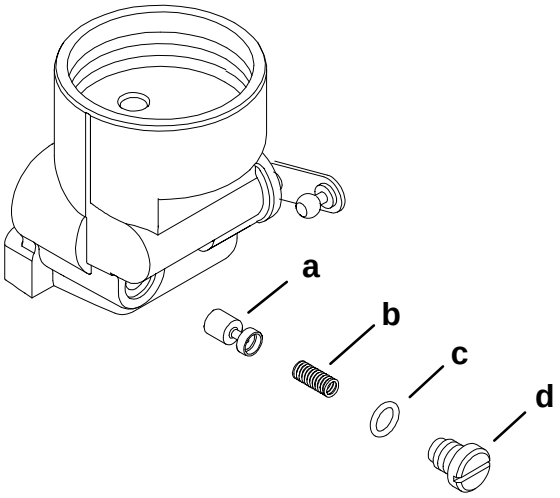


51145

a - Conical Spring
b - Steel Ball
c - Plunger
d - O-ring

VELOCITY VALVE REASSEMBLY

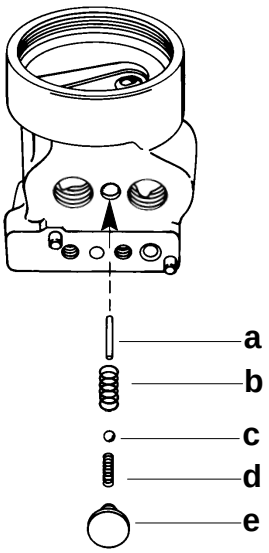
1. Install spool, spring, lubricated O-ring and screw plug (surge valve assembly) into valve block.
2. Torque screw plug to 75 lb. in. (8.5 N·m).



a - Spool
b - Spring
c - O-ring
d - Screw Plug - Torque to 75 lb. in. (8.5 N·m)

CHECK RETAINER REASSEMBLY

1. Install plunger, spring (large), ball, spring (small), and plug into valve block.

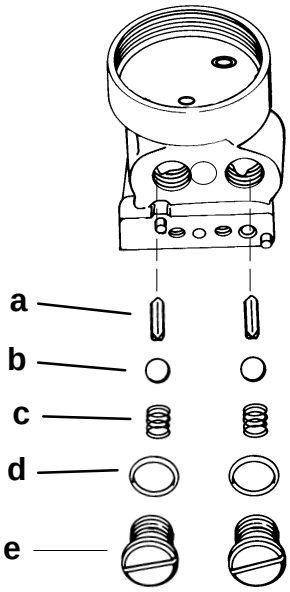


51142

a - Plunger
b - Spring (Large)
c - Ball
d - Spring (Small)
e - Plug

VALVE PLUG REASSEMBLY

1. Install plunger, steel ball, spring, lubricated O-ring and screw plug. Torque screw plugs to 75 lb. in. (8.5 N·m).

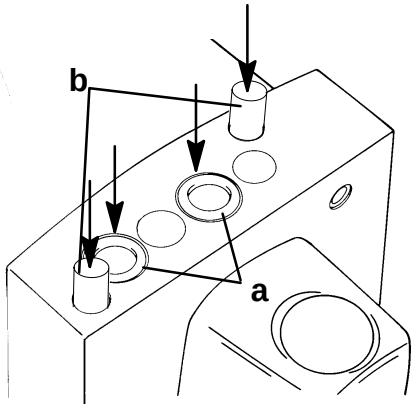


51142

a - Plungers (2)
b - Steel Balls (2)
c - Springs (2)
d - O-rings (2)
e - Screw Plugs (2) Torque to 75 lb. in. (8.5 N·m)

Valve Block Installation

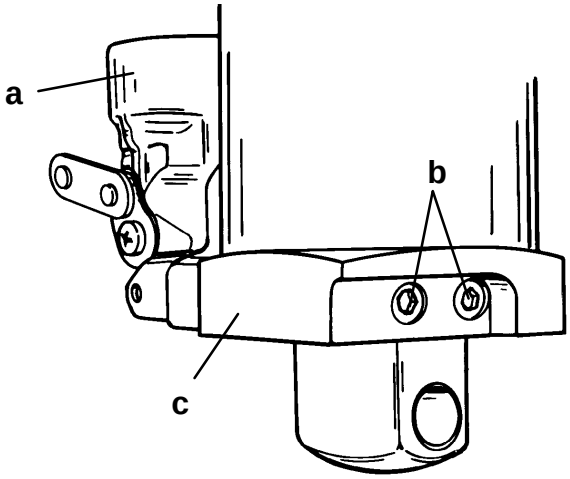
1. Install lubricated O-rings and dowel pins.



51148

a - O-rings (2)
b - Dowel Pins (2)

2. Install valve block to shock rod cylinder. Insert screws to shock rod cylinder and torque to 100 lb. in. (11 N·m).

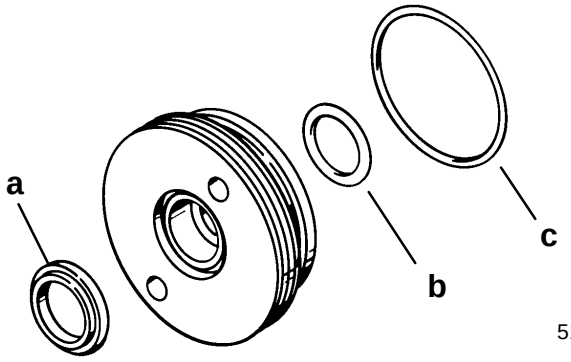


51146

a - Valve Block
b - Screws (2) Torque to 100 lb. in. (11 N·m)
c - Shock Rod Cylinder

Shock Rod Reassembly

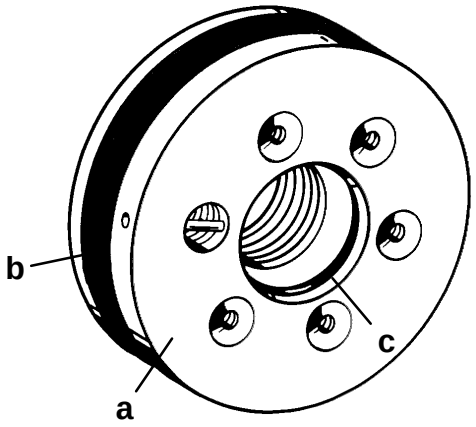
1. Install lubricated O-rings to end cap.
2. Install rod wiper.



51145

a - Rod Wiper
b - Inner O-ring
c - Outer O-ring

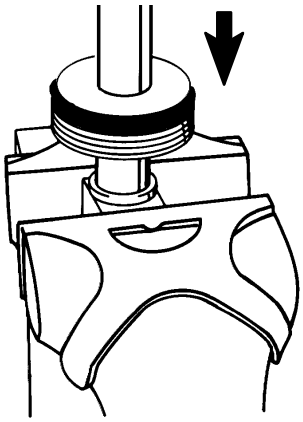
3. Install lubricated O-rings to shock piston.



51199

a - Shock Piston
b - O-ring
c - O-ring

4. Clamp shock rod in soft jawed vise.
5. Position cylinder end cap onto rod as shown.

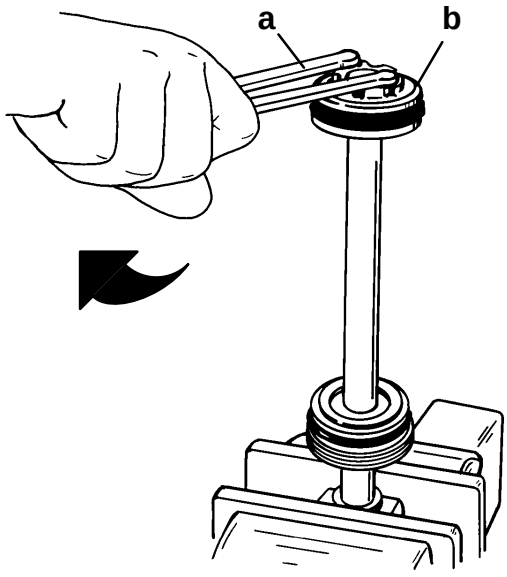


51146

⚠ CAUTION

When installing shock rod piston, spanner wrench must have1/4 in. x 5/16 in. (6.4mm x8mm) long pegs to avoid damage to shock rod piston.

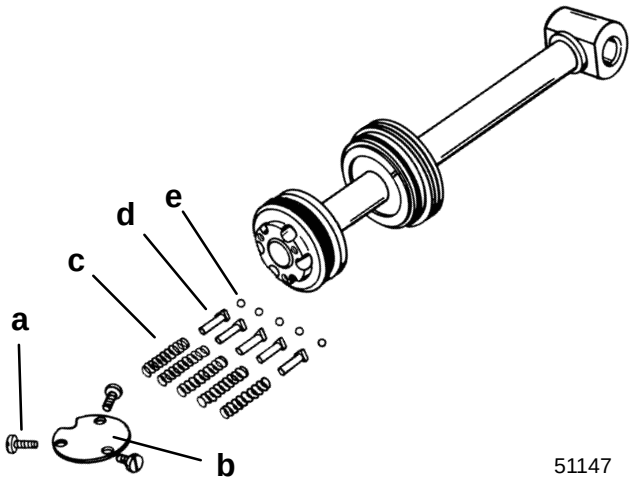
6. Apply Loctite Grade “A” (271) to threads on shock rod.
7. Install shock rod piston.
8. Tighten shock rod piston securely using spanner wrench [1/4 in. x 5/16 in. (6.4mm x 8mm) long pegs]. If a torquing type spanner tool is used to tighten shock piston, then torque to 90 lb. ft. (122 N·m).



51146

a - Spanner Wrench
b - Shock Rod Piston - Torque to 90 lb. ft. (122 N·m)

9. Install ball, seat, and spring (five sets) to shock rod piston.
10. Secure components with plate. Torque screws to 35 lb.in. (3.9 N·m).
11. Remove shock rod assembly from vise.



51147

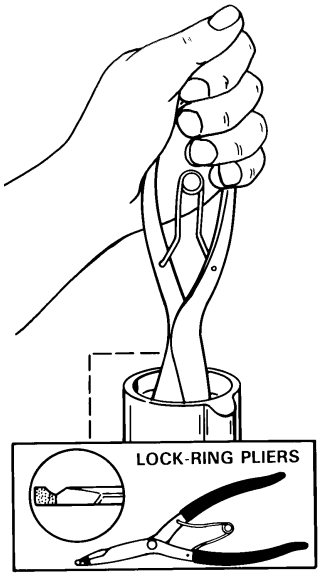
a - Screw (3) Torque to 35 lb. in. (3.9 N·m)
b - Plate
c - Spring (5)
d - Seat (5)
e - Ball (5)

Shock Rod Installation and Fluid Filling Procedure

NOTE: *There are two ways for the filling procedure. The first is the easiest and less time consuming.*

Filling Procedure Option One

1. Place trim cylinder in soft jawed vice.
2. With manifold cam lever closed (Up Position), fill cylinder and manifold to top with Quicksilver Power trim and steering fluid, or (ATF) automatic transmission fluid. Let bubbles disperse.
3. Install lubricated O-ring to memory piston.
4. Using lock ring pliers (Craftsman P/N 4735) or (Snap-on P/N SRP4) set memory piston in top of cylinder then open cam lever (Down Position) and push memory piston down just below cylinder treads. Close cam lever (Up Position).

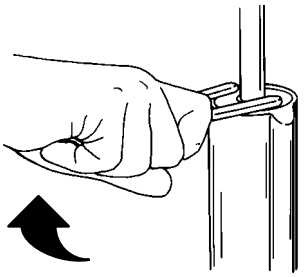


51144

5. Fill top of cylinder again with fluid to top and install shock rod assembly on top memory piston. Open cam lever (Down Position) and push shock rod assembly down to 1/8″ below cylinder threads. Close cam lever (Up Position).

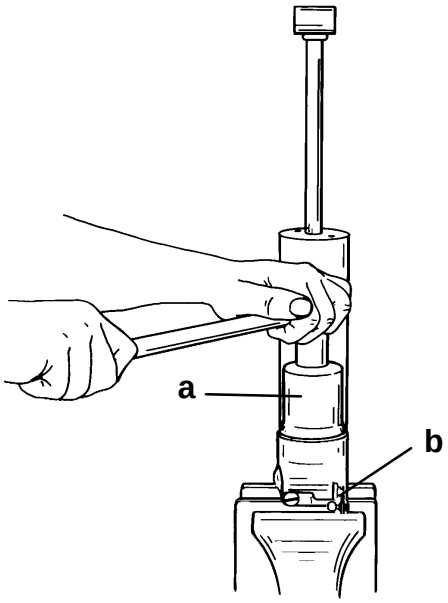


6. Fill top of shock rod assembly with fluid to top of cylinder. Open cam lever (Down Position) and screw cylinder cap down.
7. Tighten end cap securely using spanner wrench [1/4 in. x 5/16 in. (6.4mm x 8mm) long pegs]. If a torquing type spanner tool is used to tighten end cap, then torque the end cap to 45 lb. ft. (61.0 N·m). Close cam lever (up Position).



51145

8. Open and close cam lever watching for bubbles coming from accumulator check ball hole. When bubbles stop, fill accumulator opening to top with fluid. Grease threads on accumulator and opening with 2-4-C with Teflon. Start accumulator in threads and open cam lever (Down Position). Torque accumulator to 35 lb. ft. (47 N·m).

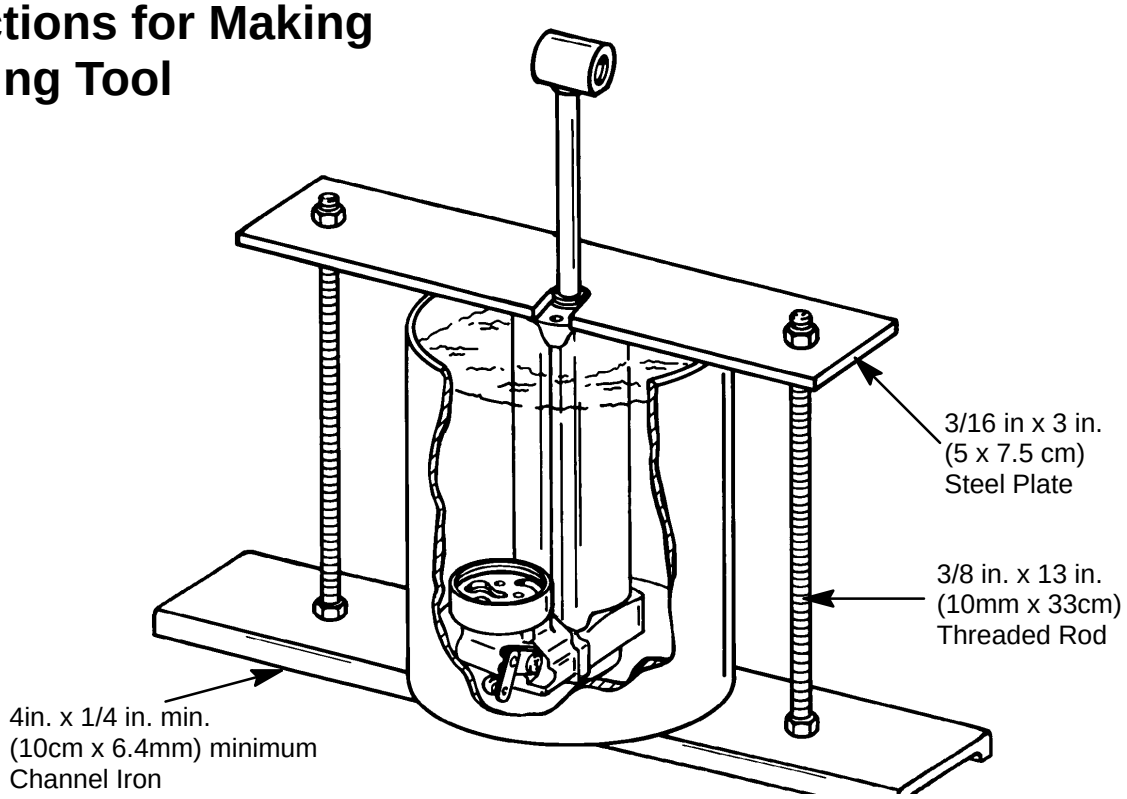


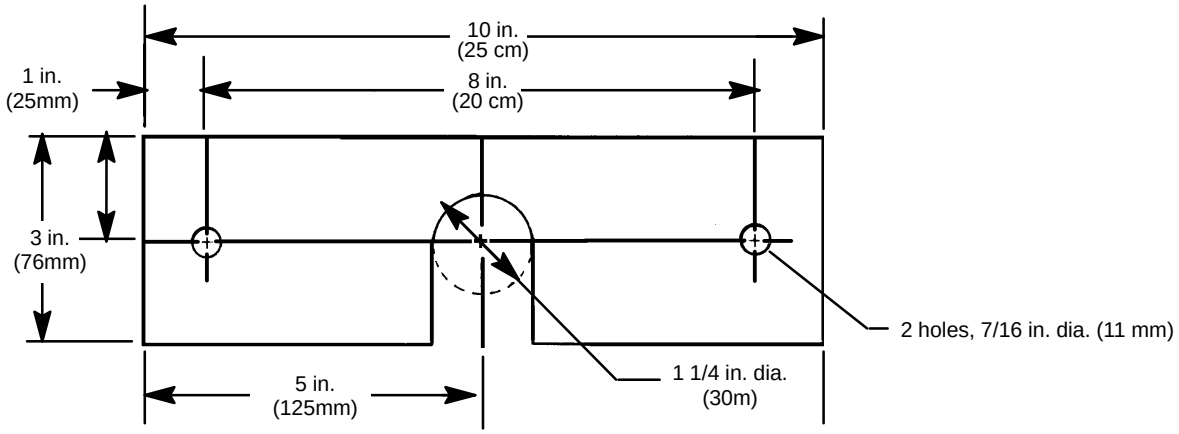
51143

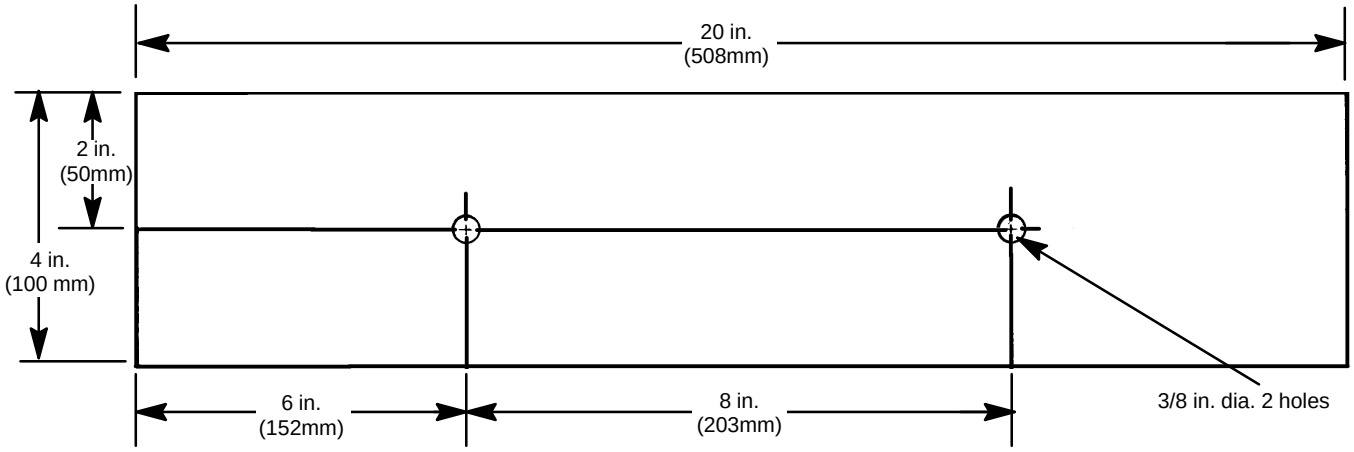
a - Accumulator
b - Cam Lever (Down Position)

NOTE: *If filling procedure is done correctly, it should be hard to turn cylinder rod assembly by hand.*

Filling Procedure Option Two Instructions for Making Retaining Tool





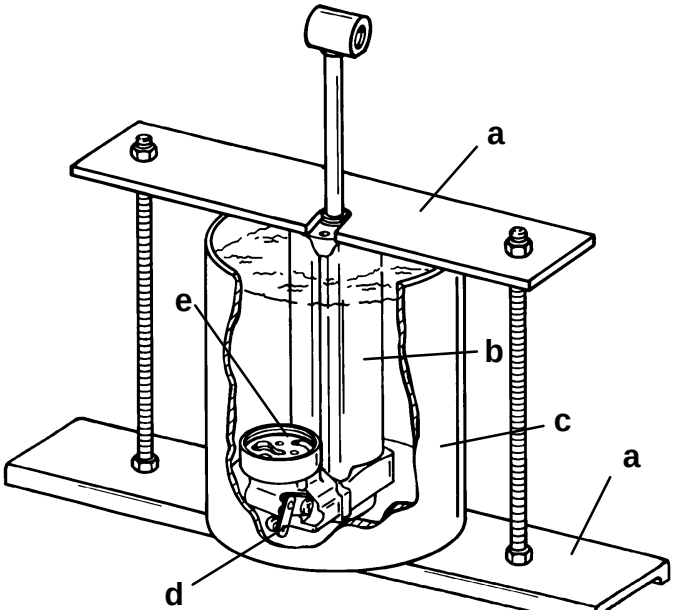


Bleeding Manual Tilt System

IMPORTANT: While bleeding tilt system, time must be allowed between each stroke to allow air bubbles to dissipate.

1. With shock rod in the full up position and manifold cam lever open (facing down), secure tilt system to retaining tool and container. (A No. 10 can or 3 lb. coffee can could be used).
2. Fill container to near full level using Quicksilver Power Trim and Steering Fluid. If not available, use automotive (ATF) automatic transmission fluid.

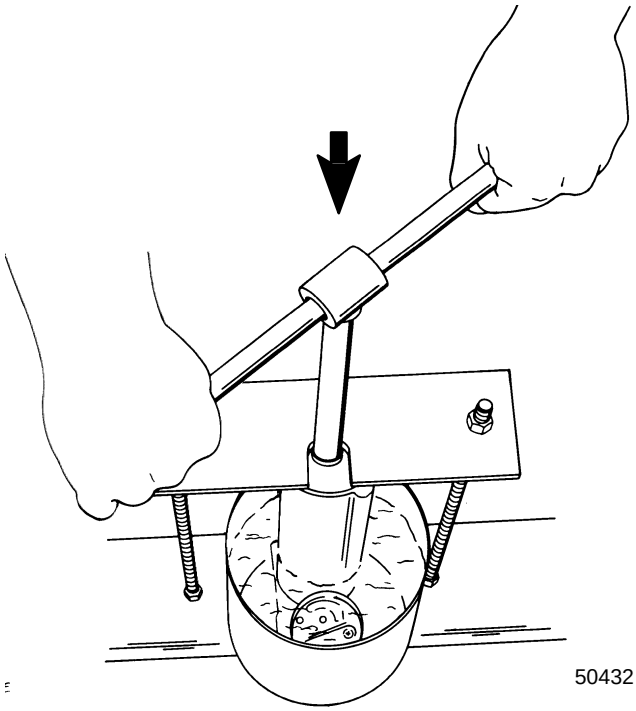
IMPORTANT: Fluid level must remain above accumulator opening during bleeding process.



50447

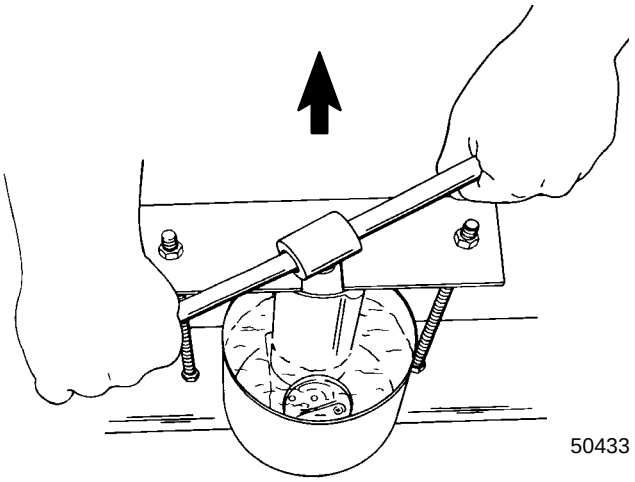
a - Retaining Tool
b - Tilt System
c - Container
d - Cam Lever
e - Accumulator Opening

3. Bleed unit by pushing rod down slowly (18-20 seconds per stroke) until stopped at base. Wait until all air bubbles exit accumulator base.



50432

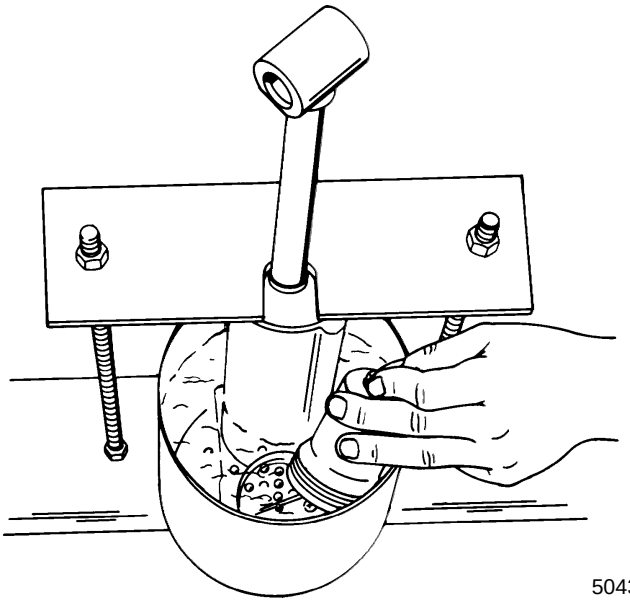
4. During up stroke, pull up on rod slowly 3 in. (76mm) from base.
5. Wait until all air bubbles exit accumulator base.



50433

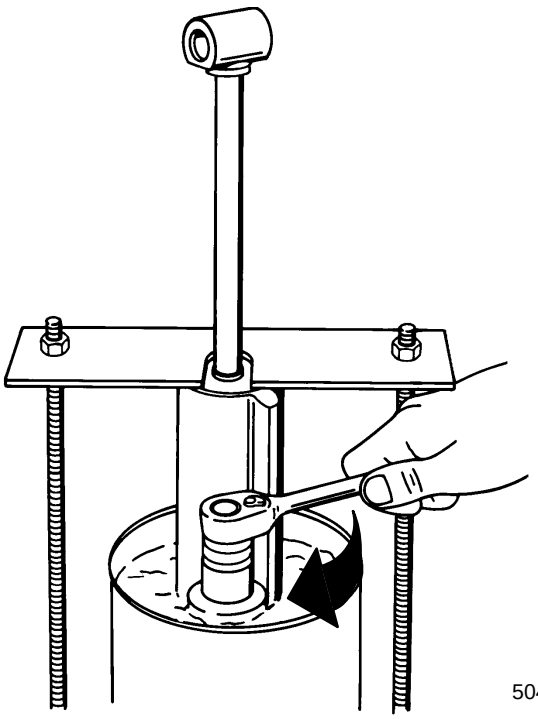
6. Slowly cycle unit 5-8 times (round trip per cycle) using short strokes 3 in. (76mm) from base allowing bubbles to disappear during each stroke.

7. Allow unit to stand five minutes then proceed to cycle unit 2-3 more times using short strokes. No air bubbles should appear from accumulator port at this time.
8. With oil level well above accumulator port, slowly pull rod to full up position.
9. Install accumulator making sure air bubbles do not enter system.



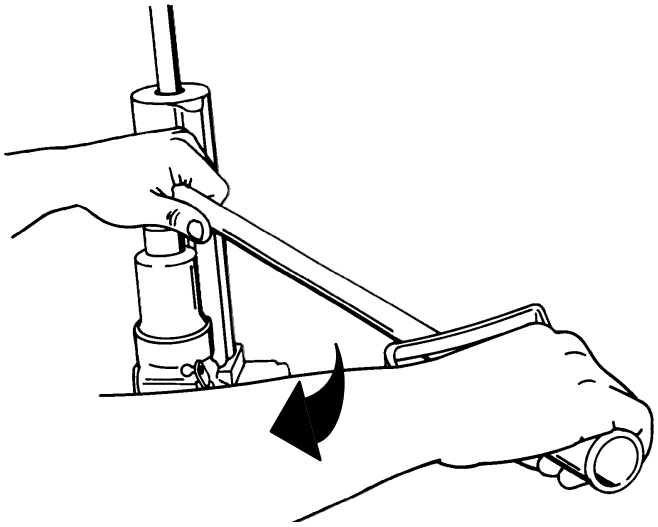
50432

10. Tighten accumulator snugly at this time.



50432

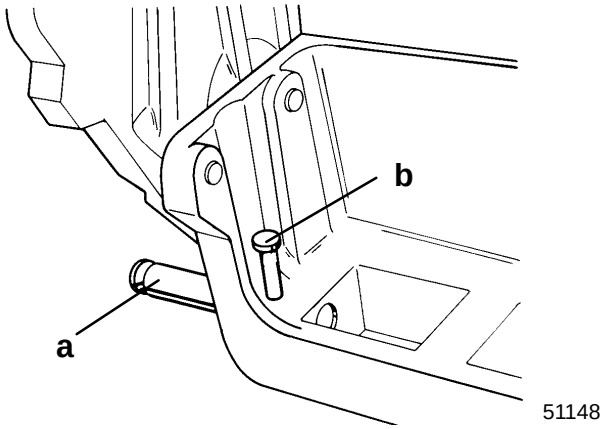
11. With cam lever remaining open (facing down), remove tilt assembly from oil and secure in soft jawed vise. Torque accumulator to 35 lb. ft. (47 N·m).



50433

Manual Tilt System Installation

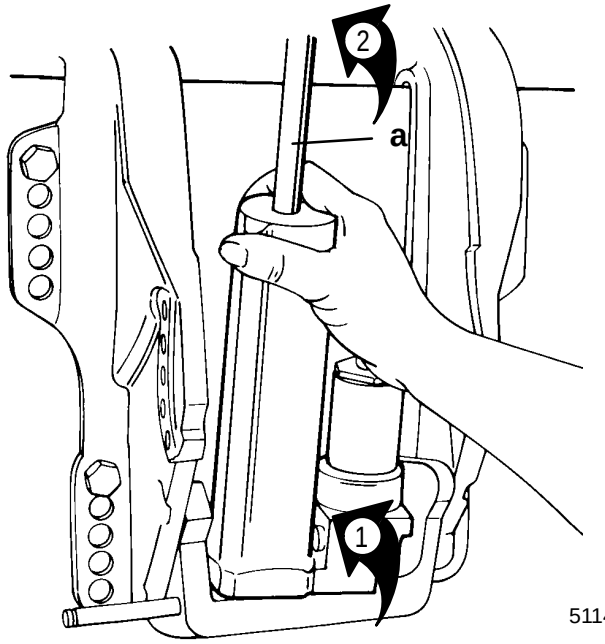
1. Apply 2-4-C Marine Lubricant to lower pivot pin hole and pivot pin surface.
2. Start lower pivot pin into pivot pin hole and position lower dowel pin (retained) in its hole.



51148

a - Lower Pivot Pin
b - Lower Dowel Pin

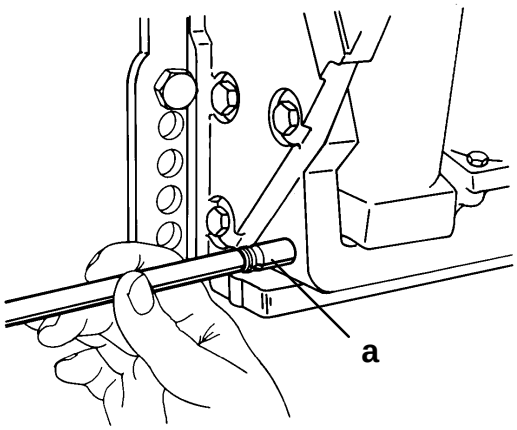
3. Reinstall manual tilt system, bottom first. Reconnect release valve link rod.



51144

a - Manual Tilt System

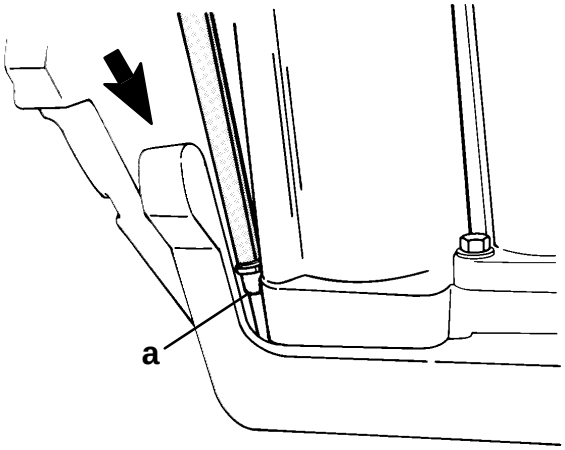
4. Using a suitable punch, drive lower pivot pin into clamp bracket and trim cylinder assembly until pivot pin is flush with outside surface.



51147

a - Lower Pivot Pin

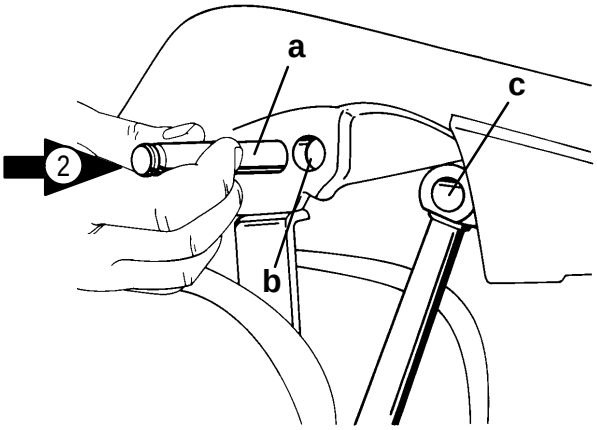
5. Using a punch, drive lower dowel pin in until seated.



51148

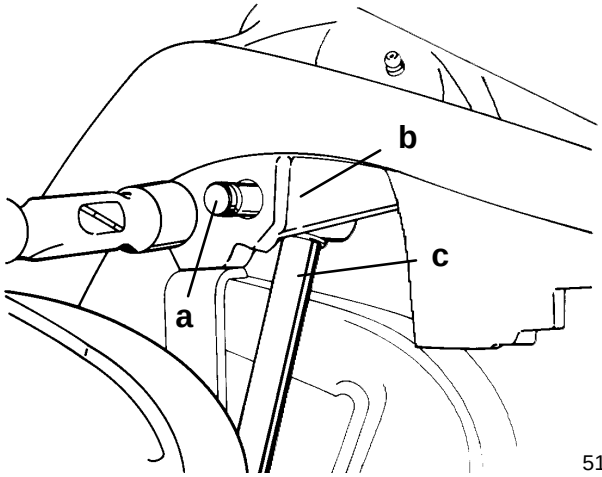
a - Lower Dowel Pin

6. Apply 2-4-C Marine Lubricant (92-90018A12) to surface of upper pivot pin, pivot pin hole and shock rod hole.



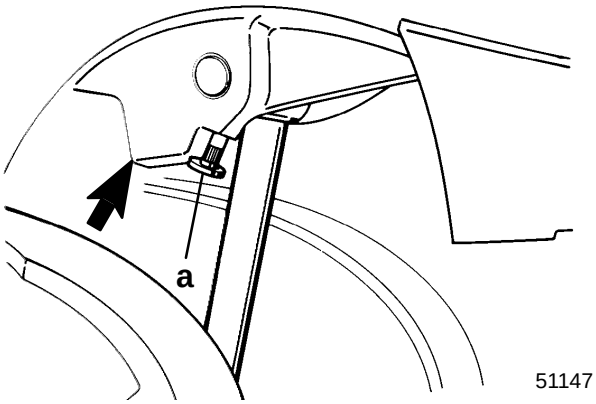
a - Pivot Pin
b - Pivot Pin Bore
c - Shock Rod Bore

7. Using a mallet, drive upper pivot pin into swivel bracket and through shock rod until pivot pin is flush with swivel bracket.



a - Pivot Pin
b - Swivel Bracket
c - Shock Rod

8. Drive upper dowel pin (a) into its hole until seated.

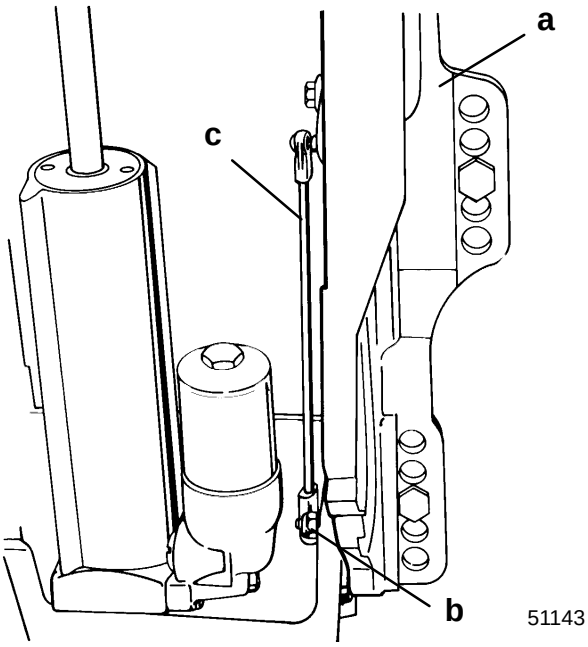


a - Dowel Pin

9. Check manual release cam adjustment. Cam must open and close freely. Adjust link rod as necessary.

Manual Release Valve Adjustment

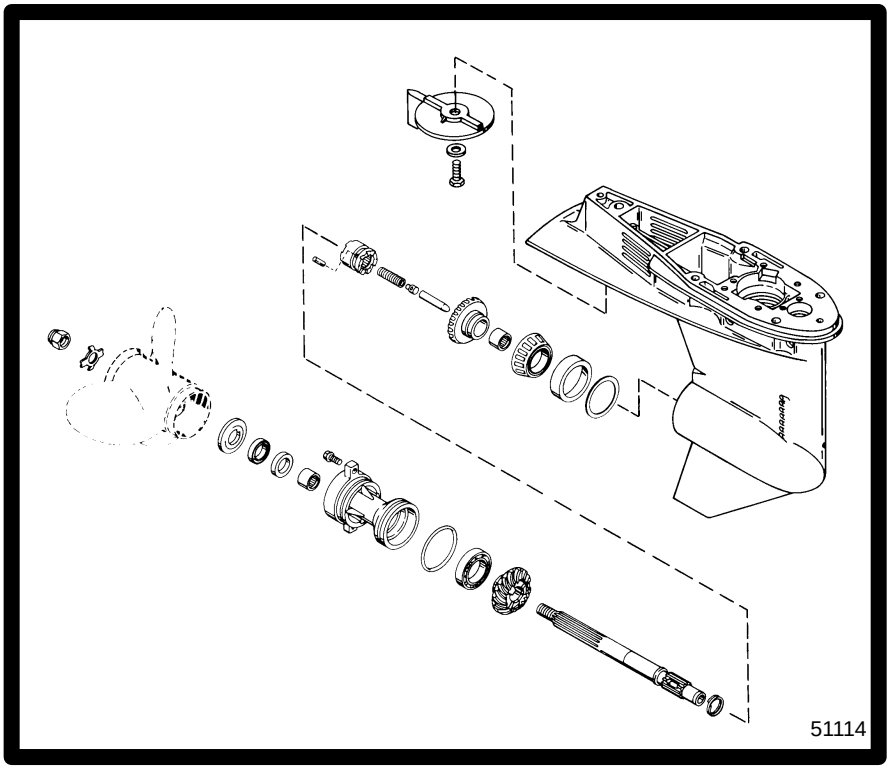
1. With outboard in full up position, place tilt lock lever forward.
2. Lift cam lever (with link rod) to full up position.



a - Tilt Lock Lever
b - Cam Lever
c - Link Rod

3. Link rod end must snap onto ball of tilt lock lever without moving tilt lock lever or cam lever.

LOWER UNIT



STANDARD GEAR HOUSING

6

A

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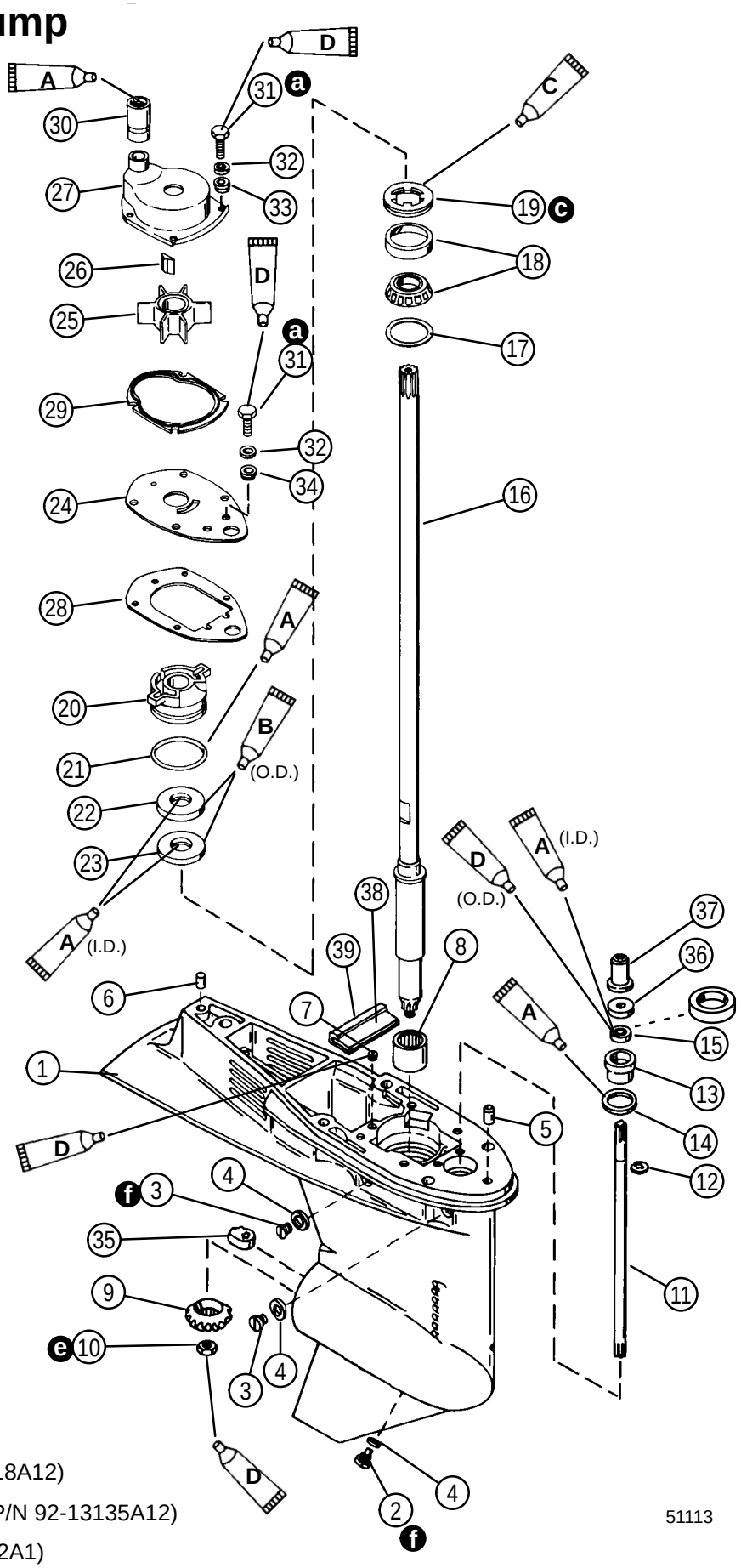
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Drive Shaft and Water Pump Components

1 - Gear Housing
2 - Drain Screw
3 - Screw
4 - Washer
5 - Dowel Pin (Hollow)
6 - Dowel Pin (Solid)
7 - Pipe Plug
8 - Roller Bearing
9 - Pinion Gear
10- Nut
11- Shift Shaft
12- Retaining Ring
13- Bushing
14- O-ring
15- Oil Seal
16- Drive Shaft
17- Shim Set
18- Tapered Roller Bearing
19- Nut
20- Water Pump Base
21- O-ring
22- Oil Seal
23- Oil Sea
24- Face Plate
25- Impeller
26- Key
27- Water Pump
28- Gasket (Lower)
29- Gasket (Upper)
30- Seal
31- Screw
32- Washer
33- Insulator (Design 1)
34- Insulator (Design 1)
35- Shift Cam
36- Spacer
37- Coupler
38- Plate
39- Seal



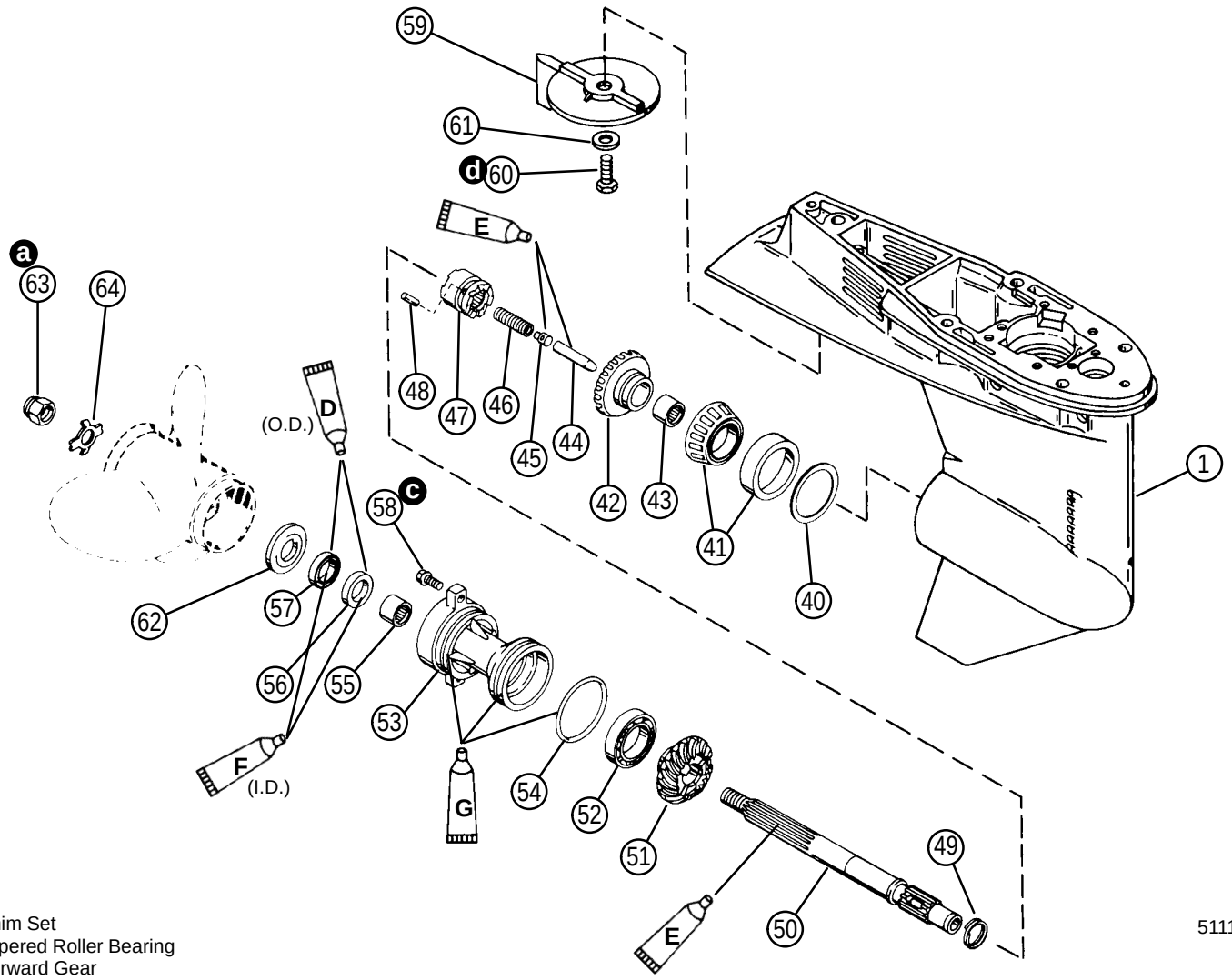
Torque Specifications

- (a) 60 lb. in. (6.8 N·m)
- (b) 20 lb. in. (2.2 N·m)
- (c) 75 lb. ft. (101.7 N·m)
- (d) 22 lb. ft. (29.8 N·m)
- (e) 50 lb. ft. (67.8 N·m)
- (f) 35-80 lb. in. (3.8-8.8 N·m)

Lubrication/Sealant Application Points

- A — 2-4-C Marine Lubricant (P/N 92-90018A12)
- B — Super Duty Marine Gear Lubricant (P/N 92-13135A12)
- C — Special Lubricant 101 (P/N 92- 13872A1)
- D — Loctite Grade A (P/N 92-32609-1)

Propeller Shaft Components



51114

40- Shim Set
41- Tapered Roller Bearing
42- Forward Gear
43- Roller Bearing
44- Cam Follower
45- Guide
46- Spring
47- Clutch
48- Cross Pin
49- Spring
50- Propeller Shaft
51- Reverse Gear
52- Ball Bearing
53- Bearing Carrier
54- O-ring
55- Roller Bearing
56- Oil Seal
57- Oil Seal
58- Screw
59- Trim Tab
60- Screw
61- Washer
62- Thrust Hub
63- Propeller Nut
64- Tab Washer

Torque Specifications

- a 55 lb. ft. (75 N·m)
- b 275 lb. in. (31.0 N·m)
- c 150 lb. in. (17.0 N·m)
- d 22 lb. ft. (30.0 N·m)

Lubrication/Sealant Application Points

- D Loctite Grade A (P/N 92-32609-1)
- E 2-4-C Marine Lubricant (P/N 92-90018A12)
- F Needle Bearing Assembly Lubricant (P/N 92-42649A-1)
- G Special Lubricant 101 (P/N 92- 13872A1)

Special Tools

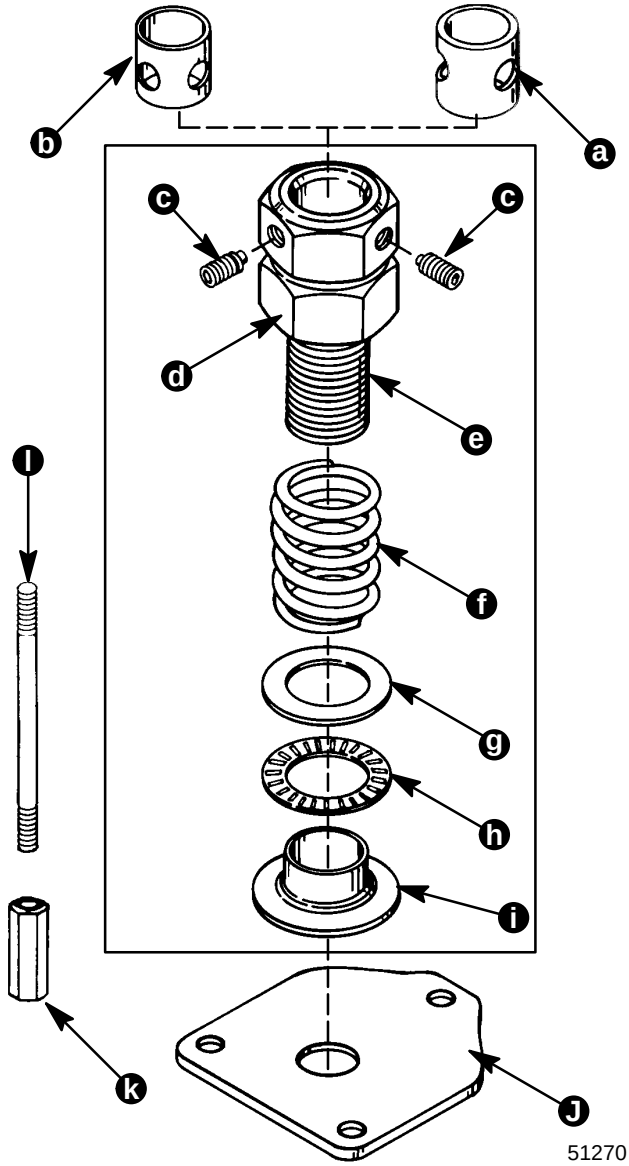
Part No.	Description
91-14311A2	Bearing Preload Tool
91-817057A1	Backlash Indicator Tool
91-19660--1	Backlash Indicator Update Kit
91-24273	Mandrel
91-27780	Puller
91-37241	Universal Puller Plate
91-37312*	Driver Head
91-37323*	Driver Rod
91-43506	Bearing Retaining Tool
91-46068A1	Puller Jaws
91-58222A1	Dial Indicator
91-83155	Dial Indicator Adaptor Kit
91-87516	Puller Bolt
91-817005	Forward Gear Bearing Installer
91-817006	Water Pump Base Seal Installer
91-817007	Bearing Carrier Seal Installer
91-817008	Pinion Gear Location Tool
91-817009	Forward Gear Bearing Race Driver Cup
91-817011	Needle Bearing Installer
91-817058A1	Lower Driveshaft Bearing Driver Assembly
91-817070	Driveshaft Holding Tool

*Tools included in Bearing Removal and Installation Kit (91-31229A5)

Quicksilver Lubricants and Service Aids

Part No.	Description
92-34227--1	Perfect Seal
92-42649A1	Needle Bearing Assembly Lubricant
92-13872A1	Special Lubricant 101
92-19007A12	Gear Lubricant
92-32609	Loctite A (271)
92-90018A12	2-4-C Marine Lubricant

New Tools Required for 50-60 Gear Housing

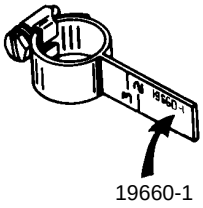


51270

Ref.	Description	Qty.
a	Bushing - 3/4 in. (19mm) I.D.	1
b	Bushing - 7/8 in. (22mm) I.D.	1
c	Set Screw	2
d	Nut	1
e	Bolt	1
f	Spring	1
g	Washer	1
h	Bearing	1
i	Adaptor	1
j	Plate	1
k	Nut	1
l	Stud	1

91-14311A-2 Bearing Preload Tool

NOTE: *Bearing Preload Tool 91-14311A-1 may be updated to a 91-14311A-2 tool, by ordering Update Kit 91-817057A-1.*



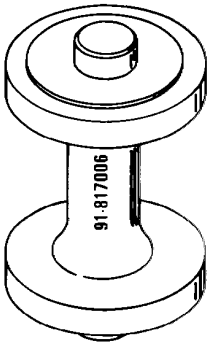
51043

91-19660--1 Backlash Indicator Tool



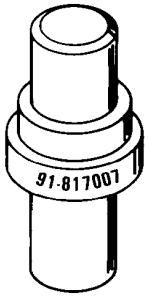
51043

91-817005 Bearing Installer (Forward Gear Needle Bearing)



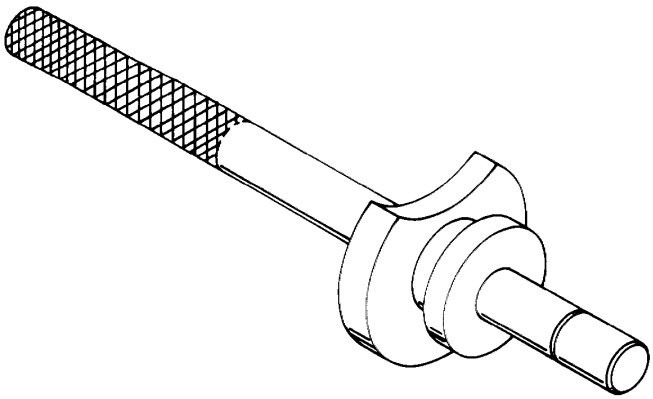
51043

91-817006 Seal Installer (Water Pump Base)



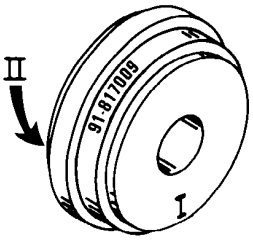
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91-817007 Seal Installer (Bearing Carrier)



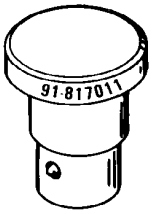
51043

91-817008A2 Pinion Gear Locating Tool



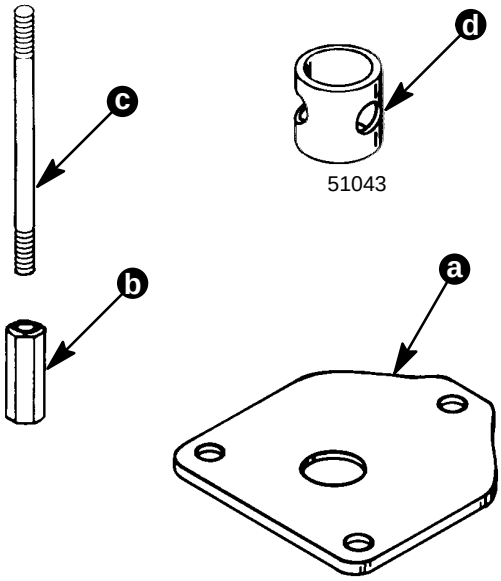
51043

91-817009 Driver Cup (Forward Gear Bearing Race)



51043

91-817011 Needle Bearing Installer (Bearing Carrier)

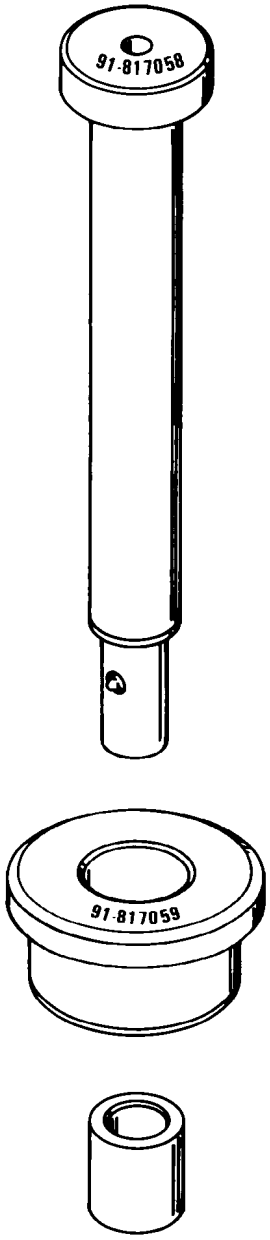


51043

51270

Ref.	Description	Qty.
a	Plate	1
b	Nut	1
c	Stud	1
d	Sleeve	1

91-817057A-1 Update Kit (Converts 91-14311A-1 Bearing Preload Kit Tool to a 91-14311A-2)



51043

91-817058A-1 Bearing Driver Assy. (Lower Drive Shaft Bearing)



51043

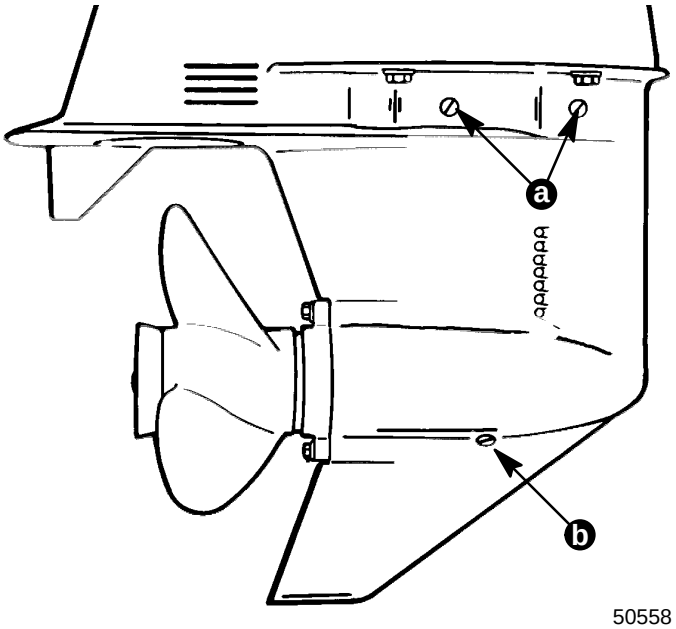
91-817070 Drive Shaft Holding Tool

Draining and Inspecting Gear Lubricant

⚠ WARNING

If gear housing is installed on outboard, disconnect (and isolate) spark plug leads from spark plugs before working near the propeller.

1. With gear housing in normal running position, place a clean pan under housing and remove two vent plugs and one fill/drain plug (with gaskets).



50558

a - Vent Plug
b - Fill/Drain Plug

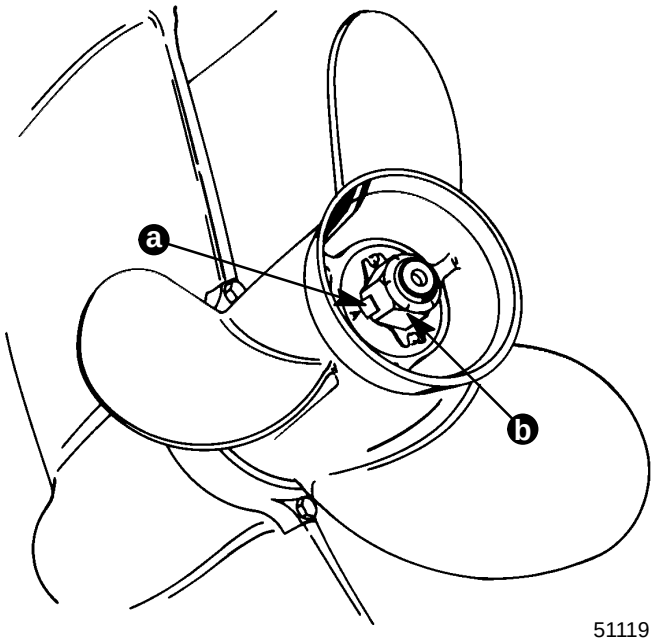
2. Inspect gear lubricant for metal particles (lubricant will have a “metal flake” appearance). Presence of fine metal particles (resembling powder) on the drain plug magnet indicates normal wear. Metal chips on the magnet indicate the need for gear housing disassembly and component inspection.
3. Note color of gear lubricant. White or cream color indicates presence of water. Gear lubricant drained from a gearcase recently in operation will have a yellowish color due to lubricant agitation/aeration. This is normal and should not be confused with the presence of water.
4. Presence of water indicates the need for disassembly and inspection of oil seals, o-rings, gaskets and components for damage.

Propeller Removal

⚠ WARNING

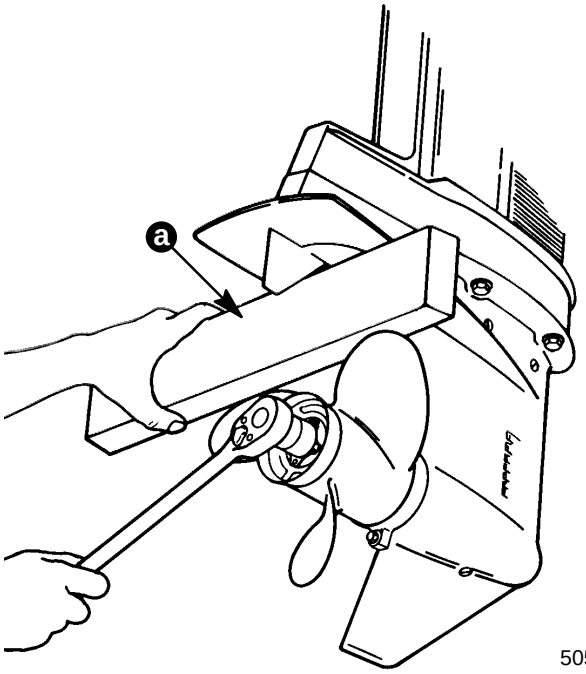
If gear housing is not removed from outboard, before attempting to remove or install the propeller, remove (and isolate) spark plug leads from spark plugs to prevent outboard from starting.

1. Bend tabs of tab washer (a) away from nut (b).



51119

2. Use a block of wood (a) to prevent propeller from rotating. Remove nut and pull components from shaft.



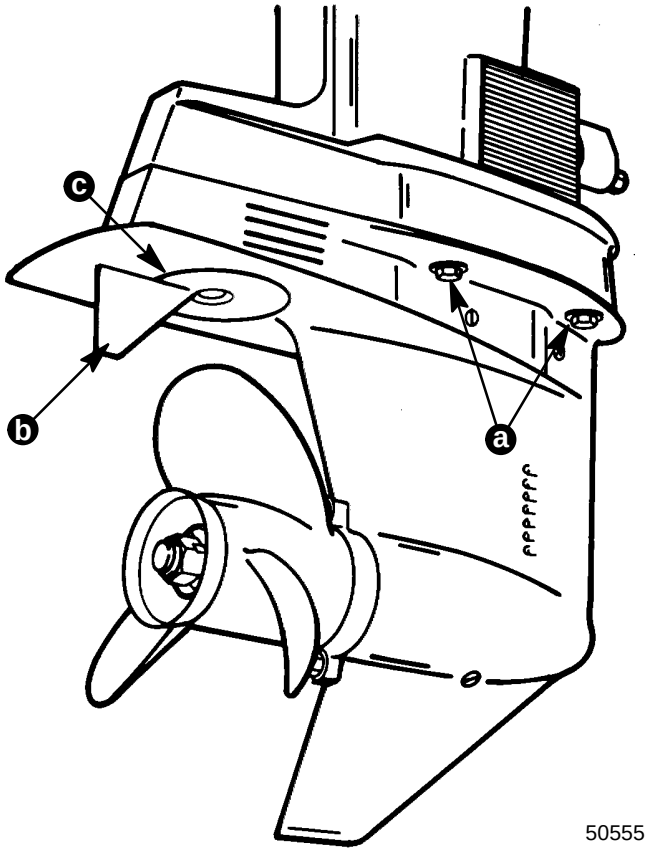
50552

Gear Housing Removal

⚠ WARNING

To prevent accidental engine starting, remove (and isolate) spark plug leads from spark plugs before removing gear housing.

1. Remove (and isolate) spark plug leads from spark plugs.
2. Shift into forward gear.
3. Tilt engine to full “Up ” position.
4. Remove four bolts and washers (a), two from each side.
5. Remove trim tab (b).
6. Remove locknut and washer (c) in trim tab recess.
7. Remove gear housing.



50555

Gear Housing Disassembly

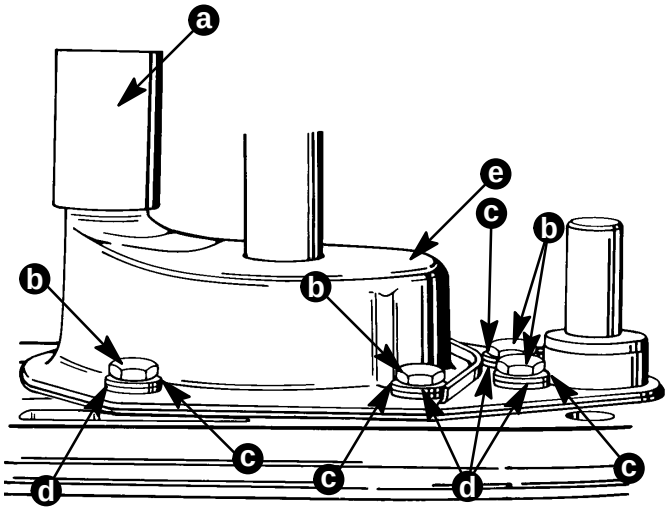
Water Pump

1. If water tube seal (a) stayed on water tube (inside of driveshaft housing) when gear housing was removed, then pull seal from water tube. Replace water tube seal (a) if damaged.
2. Remove 6 bolts (b), washers (c) and isolators (d) (Design 1). Remove cover (e).

NOTE: *Isolators (d) from forward 2 screws are different from the other isolators. Retain these for proper re-assembly (Design 1).*

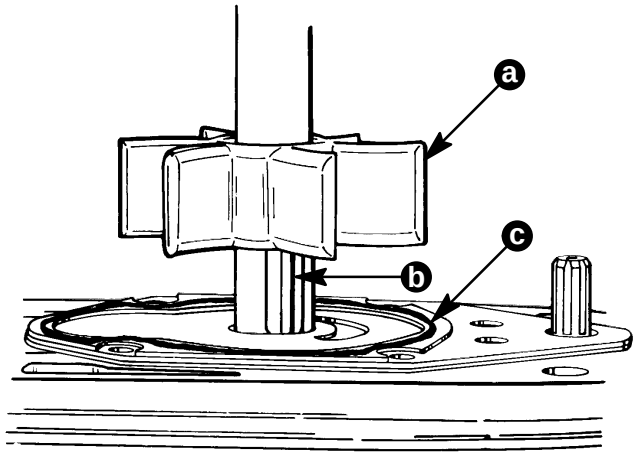
IMPORTANT: The circular groove formed by the impeller sealing bead should be disregarded when inspecting cover and plate as the depth of the groove will not affect water pump output.

3. Replace cover if thickness of steel at the discharge slots is .060 in. (1.524mm) or less, or if groove(s) (other than impeller sealing groove) in cover roof are more than .030 in. (.762mm) deep.



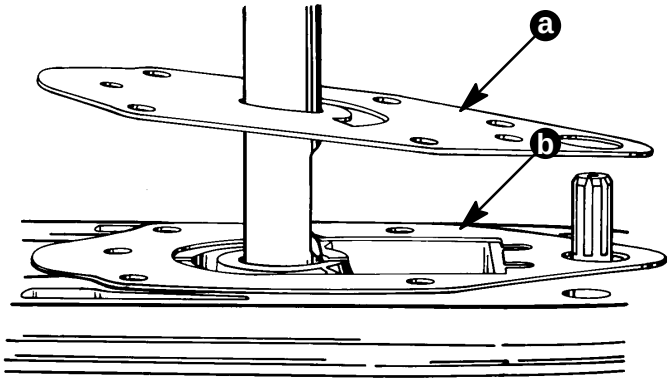
51206

4. Lift impeller (a), drive key (b), and gasket (c). Replace impeller if:
   - Impeller blades are cracked, torn, or worn.
   - Impeller is glazed or melted (caused by insufficient water supply).
   - Rubber portion of impeller is not bonded to impeller hub.



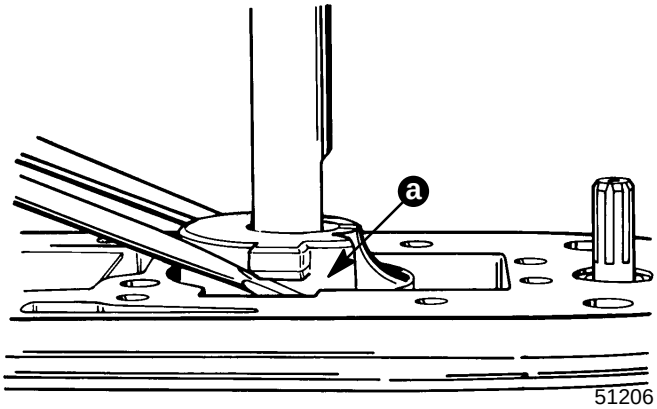
51207

5. Remove plate (a) and gasket (b).
6. Replace plate if groove(s) (other than impeller sealing groove) in plate are more than .030 in. (.762mm) deep.



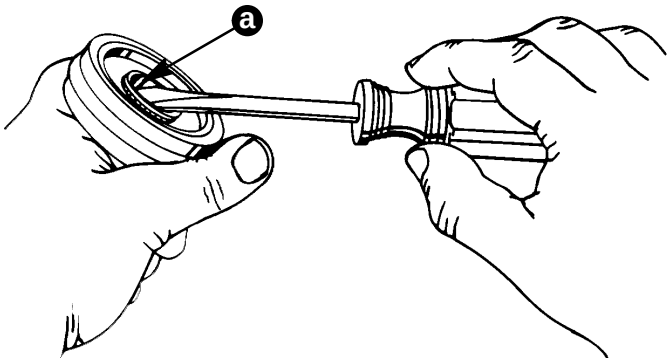
51206

7. Remove water pump base (a) by lifting gently as shown.



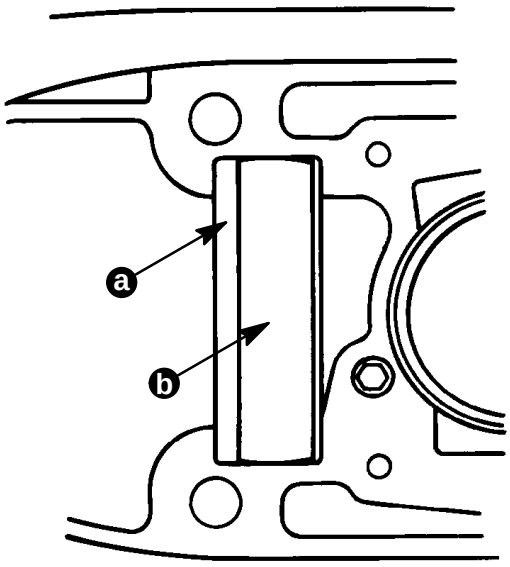
51206

8. Remove (and discard) seals (a), if damaged.



51205

9. Remove seal and plate if damaged or worn.

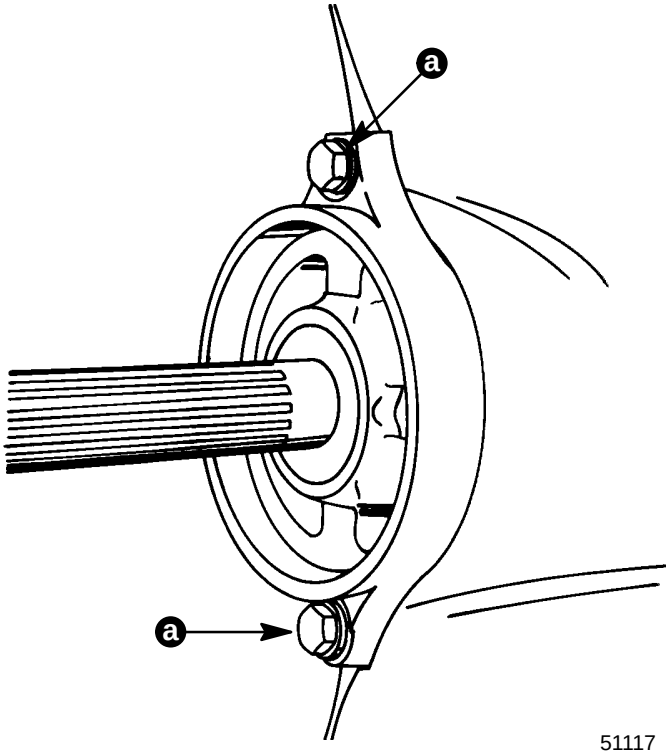


51268

a - Seal
b - Plate

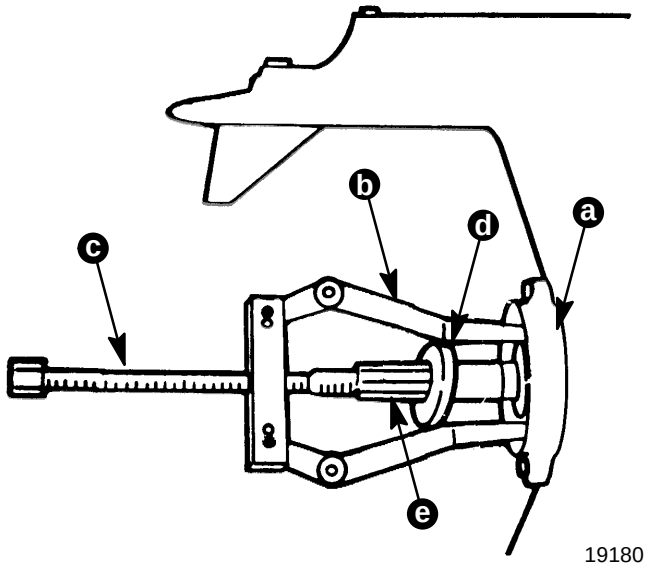
Bearing Carrier and Propeller Shaft

1. Drain lubricant; refer to “Draining and Inspecting Gear Lubricant”.
2. Remove bolts (a).



51117

3. With propeller shaft horizontal, pull carrier to break seal with gear housing. Remove bearing carrier/propeller shaft components. Do not leave cam follower in end of propeller shaft. Remove propeller shaft from bearing carrier using bearing puller.

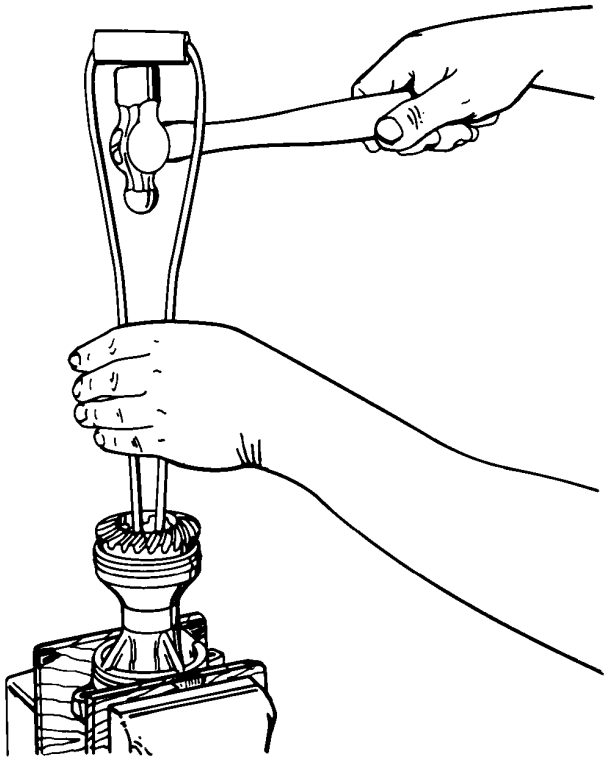


19180

a - Bearing Carrier
b - Puller Jaws (91-46086A1)
c - Puller Bolt (91-85716)
d - Thrust Hub
e - Propeller Shaft

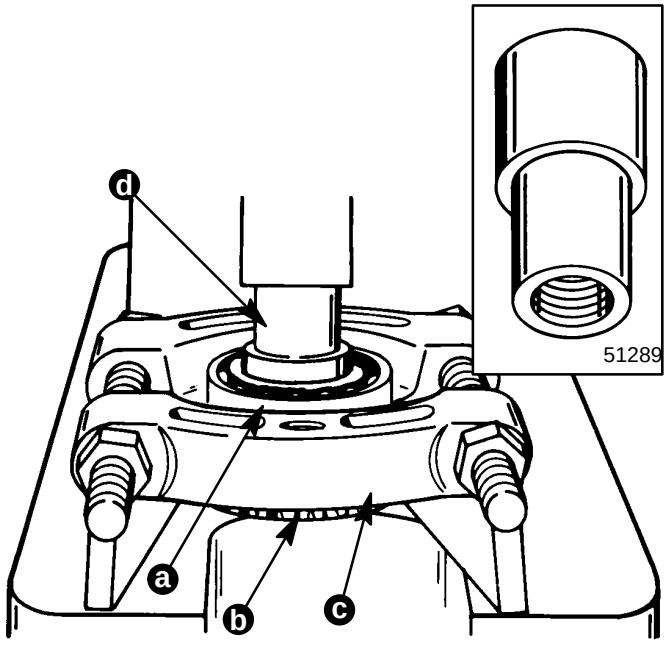
4. Replace reverse gear if gear teeth or clutch teeth on reverse gear are chipped or worn. If reverse gear must be replaced, pinion and sliding clutch should also be inspected for damage.

5. If reverse gear bearing is rusted or does not roll freely, replace bearing. Remove bearing and reverse gear using bearing puller (91-27780).



51205

6. Remove ball bearing (a) from reverse gear (b) using Universal Puller Plate (c) and mandrel (d).

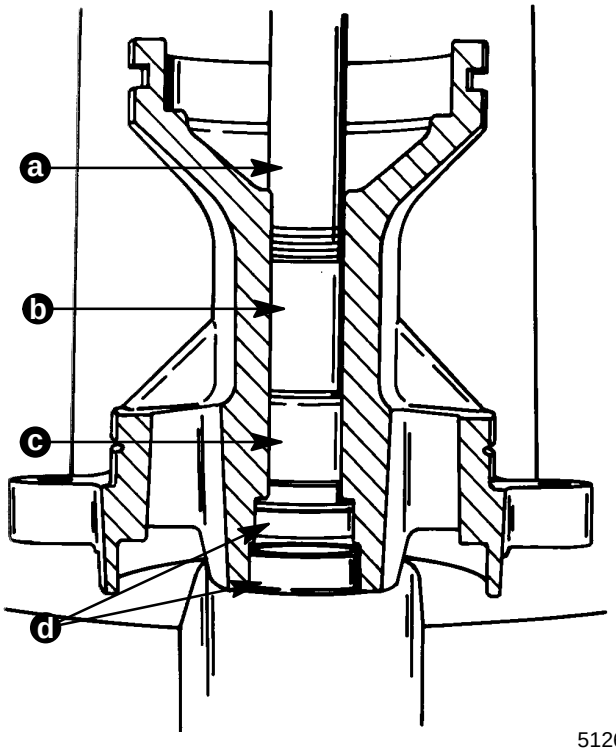


51289

51269

a - Ball Bearing
b - Reverse Gear
c - Universal Puller Plate (91-37241)
d - Driver Head (91-37312)

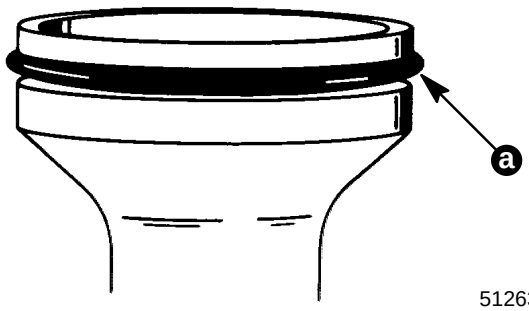
7. If bearing (c) is rusted or does not roll freely, replace bearing. Remove bearing and oil seals. Discard oil seals.



51264

a - Driver Rod (91-37323)
b - Driver Head (91-37312)
c - Propeller Shaft Needle Bearing
d - Oil Seals (2)

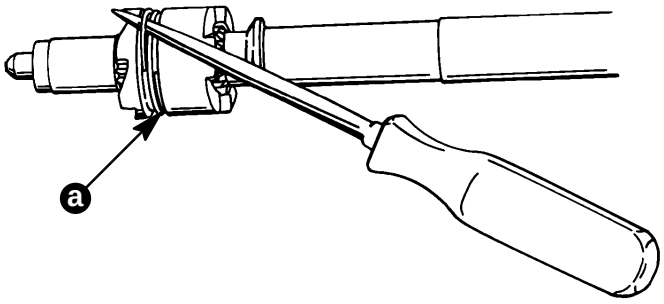
8. Remove seals (if not removed with bearing) and O-ring (a).



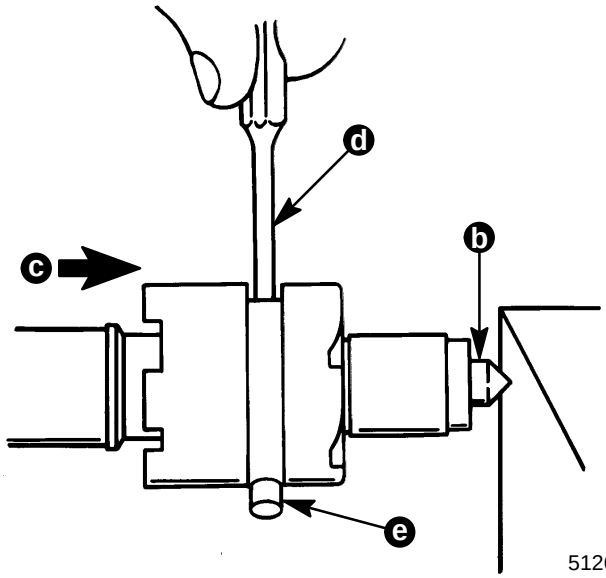
51263

Propeller Shaft Disassembly

1. Remove spring (a). Push out cross pin (e).



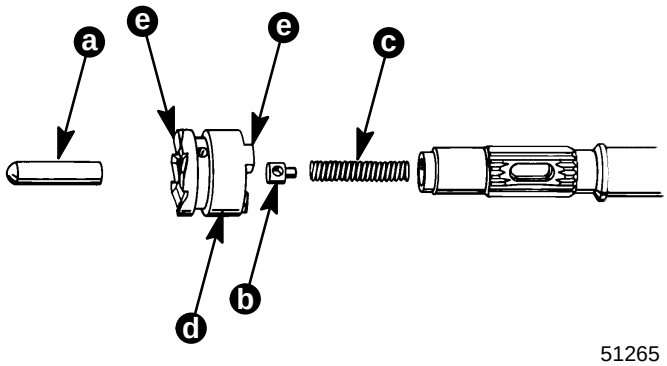
51265



51268

a - Spring
b - Cam Follower
c - Apply Pressure as Shown
d - Punch
e - Cross Pin

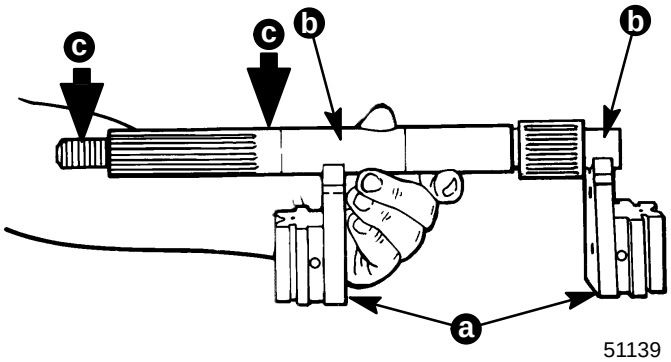
2. Replace cam follower if worn or pitted on either end.
3. Replace sliding clutch if jaws are rounded or chipped. Rounded jaws indicate the following:
   a. Improper shift cable adjustment.
   b. Engine idle speed too high while shifting.
   c. Shifting too slowly.



51265

a - Cam Follower
b - Guide Block
c - Spring
d - Sliding Clutch
e - Jaws

4. Check bearing surfaces of propeller shaft. If shaft is worn/pitted, replace shaft and corresponding bearing.
5. Replace propeller shaft if:
   a. Splines are twisted or worn.
   b. Oil seal surface (b) is grooved in excess of 0.005 in. (0.12mm).
   c. Shaft has a noticeable “wobble” or is bent more than 0.006 in. (.152 mm). Check with a dial indicator and V-blocks.

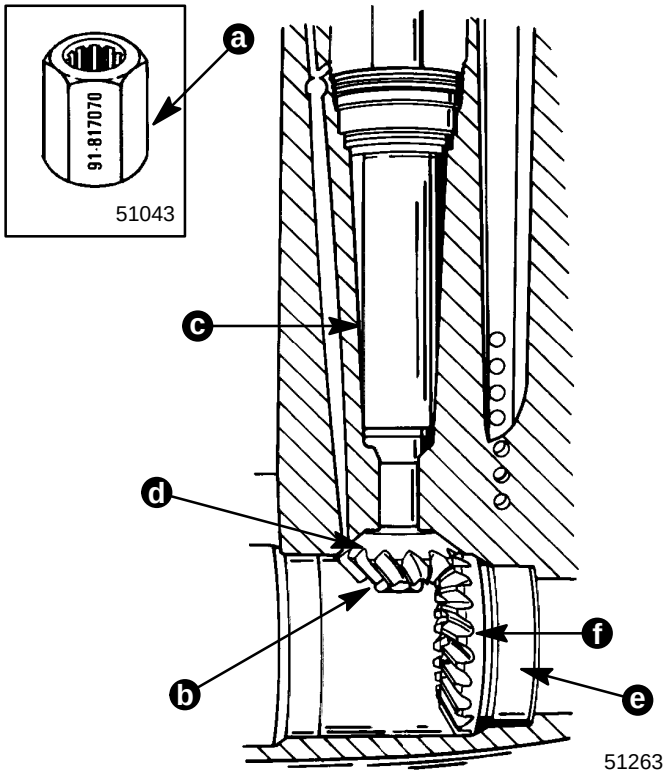


51139

a - “Vee” Blocks
b - Bearing Surfaces
c - Check with Dial Indicator Here

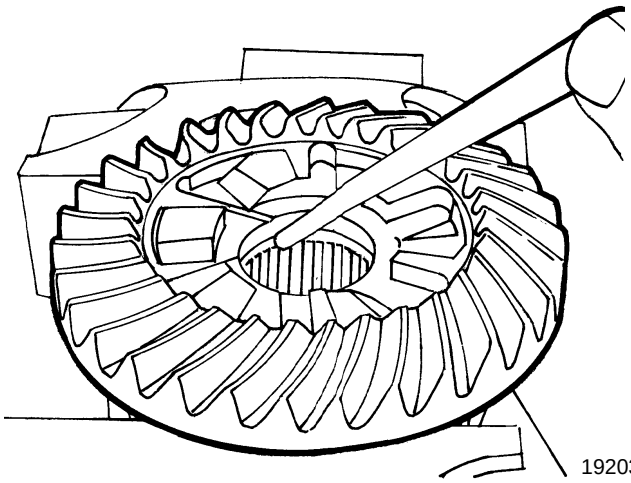
Pinion Gear, Driveshaft and Forward Gear

1. Hold driveshaft using Driveshaft Holding Tool (a) (91-817070); remove (and discard) pinion nut (b).
2. Remove driveshaft (c), pinion gear (d), and forward gear (f).
3. Replace pinion gear (d) if chipped or worn.
4. Replace bearing (e) if rusted or damaged; or does not roll freely. To remove, refer to “Lower Driveshaft Bearing”, following.
5. Replace forward gear (f) if gear teeth are chipped or worn.

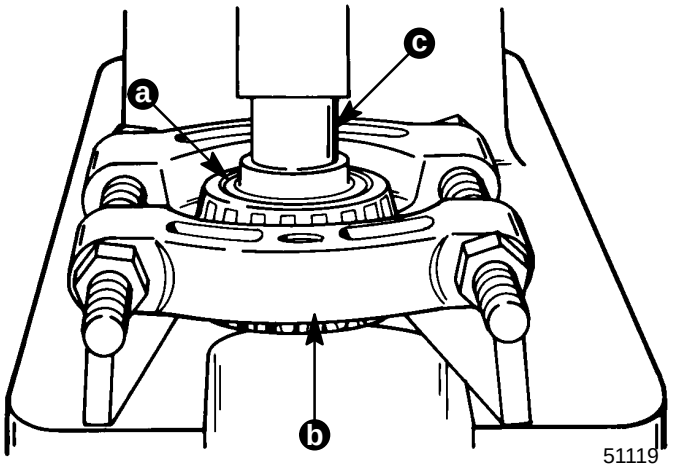


51043
51263

6. Replace bearing if rusted or does not roll freely after cleaning in solvent. Remove as shown.


19203

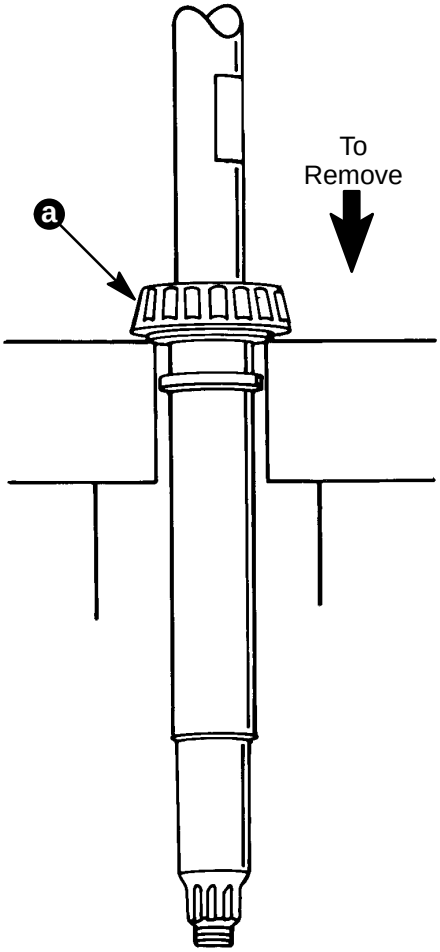
7. Replace forward gear tapered roller bearing (a) and race if either bearing or race are rusted or damaged; or if bearing does not roll freely after cleaning in solvent. Remove bearing from gear using Universal Puller Plate (b) (91-37241) and Mandrel (c). To remove race, refer to “Forward Gear Bearing Race”, following.



51119

Upper Driveshaft Bearing

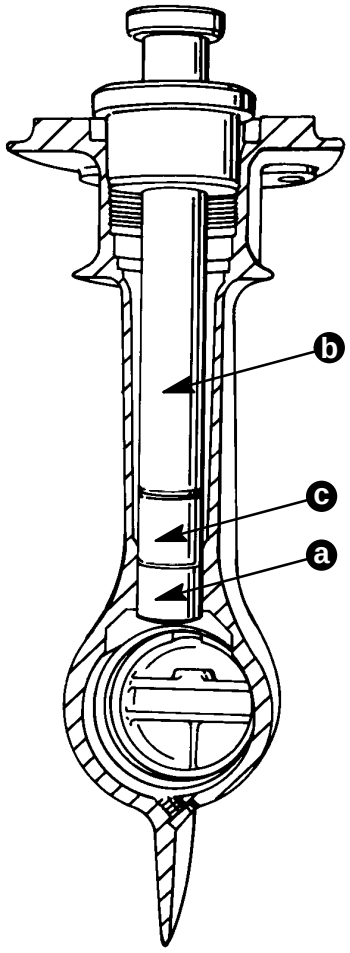
1. Replace bearing (a) and race if either bearing or race are rusted or damaged; or if bearing does not roll freely after cleaning in solvent.



51271

Lower Driveshaft Bearing

1. Remove lower driveshaft bearing using tool (91-817058A1) with bushing installed.



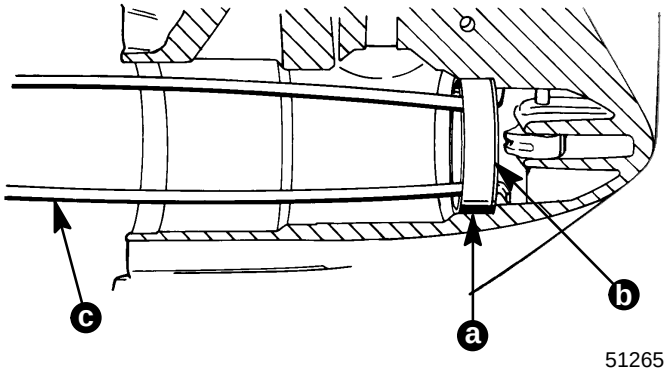
51260

a - Bearing
b - Removal Tool (91-817058A1)
c - Bushing

Forward Gear Bearing Race

IMPORTANT: Retain shim(s) for re-assembly.

1. Remove race (a) and shim(s) (b) using bearing puller (c) (91-27780).

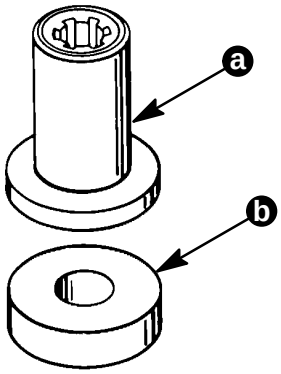


51265

a - Race
b - Shim(s)
c - Bearing Puller (91-27780)

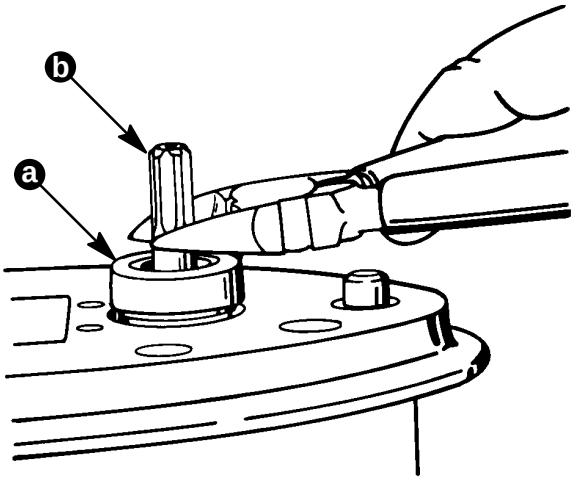
Shift Shaft

1. Remove shift shaft coupler (a) and spacer (b).



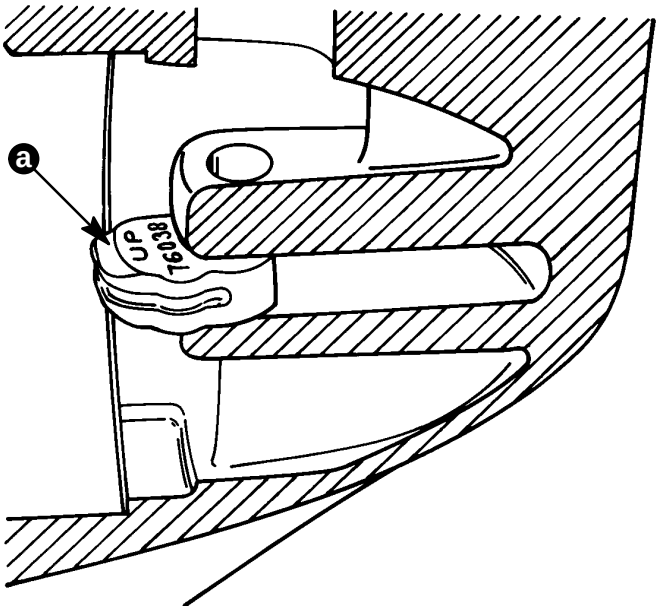
51271

2. Remove shift shaft bushing (a) and shift shaft (b). Protect shift shaft to prevent spline damage.



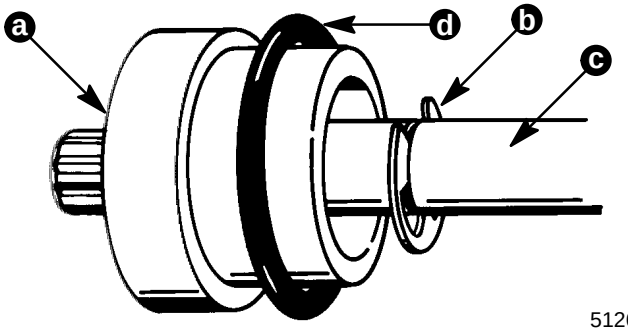
51205

3. Remove shift shaft cam (a); replace if worn.



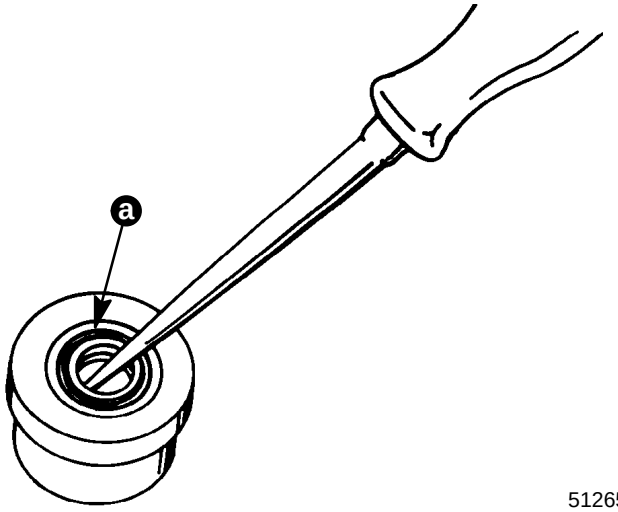
51117

4. Remove shift shaft bushing (a) and clip (b) from shift shaft (c). Replace shift shaft if splines are twisted or damaged on either end of shaft. Remove (and discard) O-ring (d) if damaged.



51264

5. Remove (and discard) seal (a) if damaged.



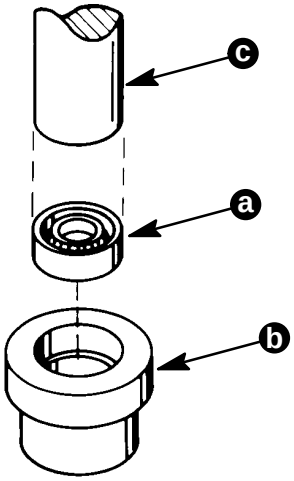
51265

Gear Housing Reassembly

Shift Shaft

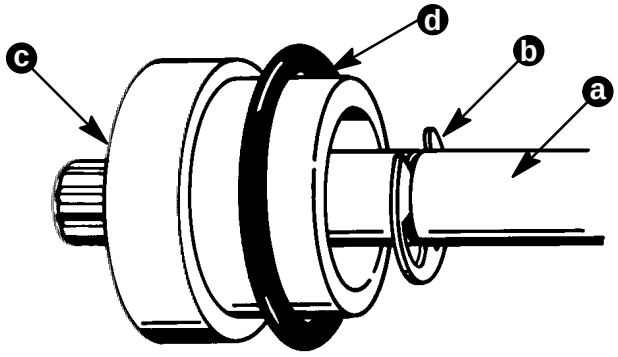
1. Apply Perfect Seal on O.D. of new seal (a). Install with seal lip up as shown.
2. Press seal into shift shaft bushing (b) until seal bottoms. Use a suitable tool (c).

Apply Quicksilver Needle Bearing Assembly Lubricant on O-ring and I.D. of seal.



51270

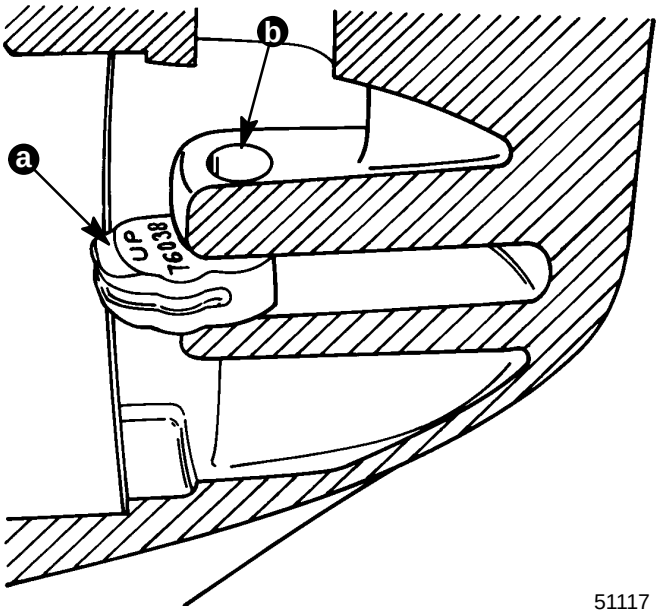
3. Assemble components.



51264

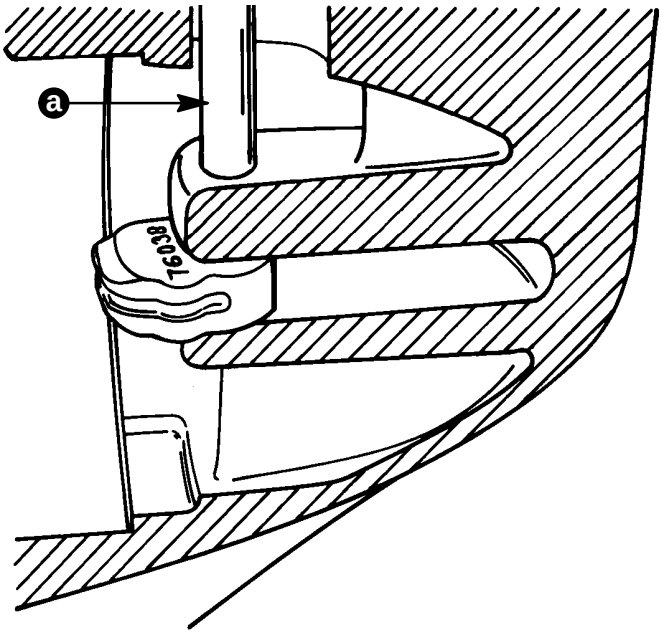
a - Shift Shaft
b - “E” Clip
c - Bushing
d - O-ring

4. Install shift cam (a) (numbers toward top of gear housing); align hole in shift cam with hole (b).



51117

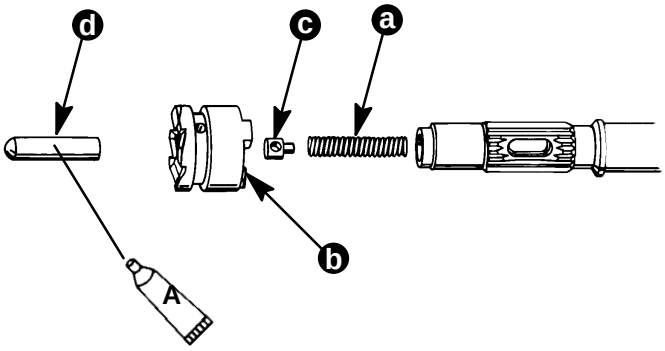
5. Install shift shaft assembly (a); insert splines into shift cam.



51268

Propeller Shaft

1. Install components.

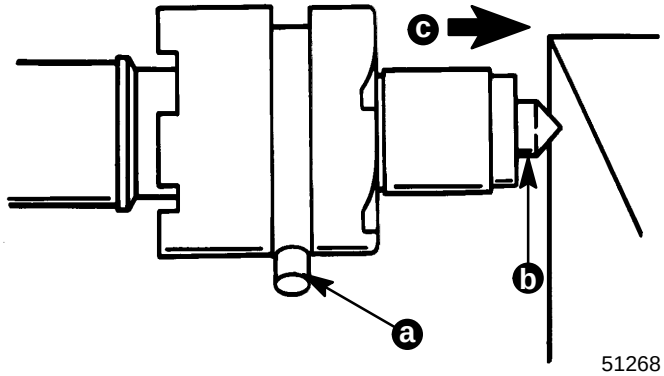


51265

A 2-4-C Quicksilver Marine Lubricant

a - Spring
b - Clutch (Align Hole with Slot in Propshaft; Long End of Clutch with 3 Teeth Towards Propshaft Shoulder)
c - Guide Block
d - Cam Follower (Hold in Place with Quicksilver 2-4-C Marine Lubricant

2. Install cross pin.

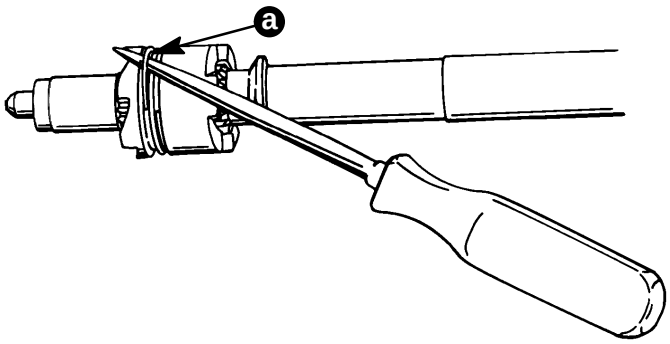


51268

a - Cross Pin
b - Cam Follower
c - Apply Pressure in This Direction

3. Install spring.

NOTE: *Spring windings must lay flat with no overlapping in clutch groove after installation.*

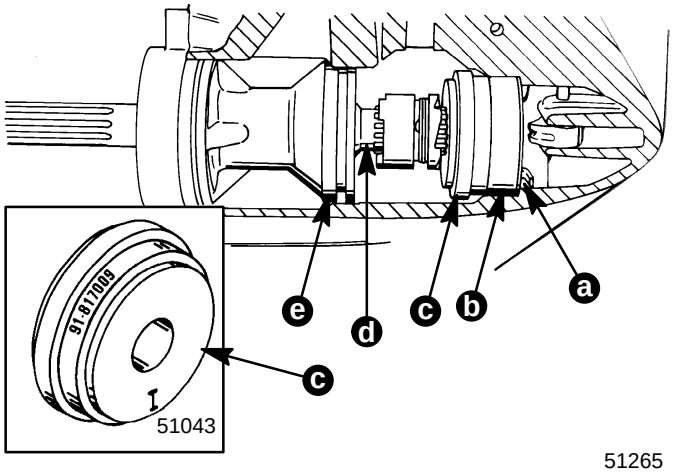


51265

a - Spring

Forward Gear Bearing Race

1. Place shim(s) retained from disassembly into housing. If shim(s) were lost or damaged, or a new gearcase is being assembled, start with a .010 in. (.254mm) shim.
2. Drive bearing race into housing. Use a lead hammer to avoid damage to propshaft.



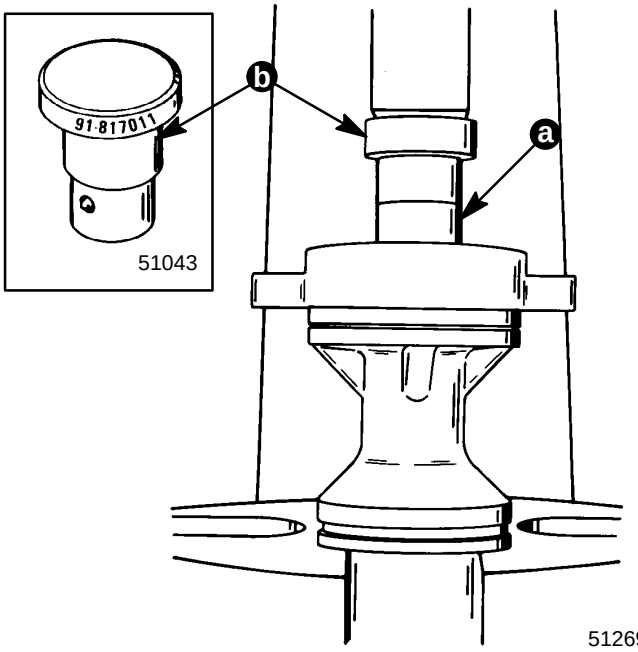
51265

a - Shim(s)
b - Race (Apply Quicksilver Needle Bearing Assembly Lubricant on O.D.)
c - Driver Cup (91-817009)
d - Propeller Shaft
e - Assembled Bearing Carrier

Bearing Carrier

1. Lubricate O.D. of needle bearing (a) with Quicksilver Needle Bearing Assembly Lubricant.
2. Install needle bearing.

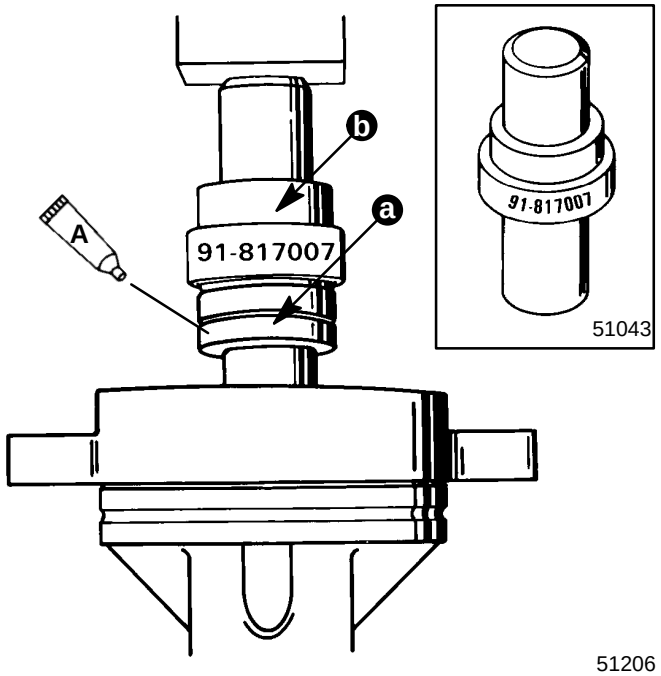
Installation Note: Push against numbered end of bearing.



51269

a - Needle Bearing
b - Installer (91-817011)

3. Install small diameter oil seal (a). Seal lip faces away from shoulder on Installer Tool. Press seal in until Installer Tool bottoms.

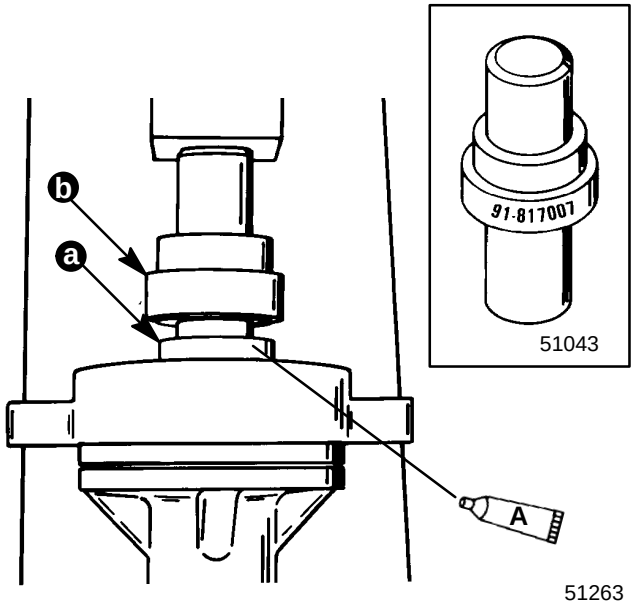


51206

A Loctite Grade A (O.D. of Seal)

a - Small Diameter Seal
b - Installer Tool (91-817007)

4. Install large diameter seal (a) on Installer Tool. Seal lip faces towards shoulder on Installer Tool. Press in until Installer tool bottoms.

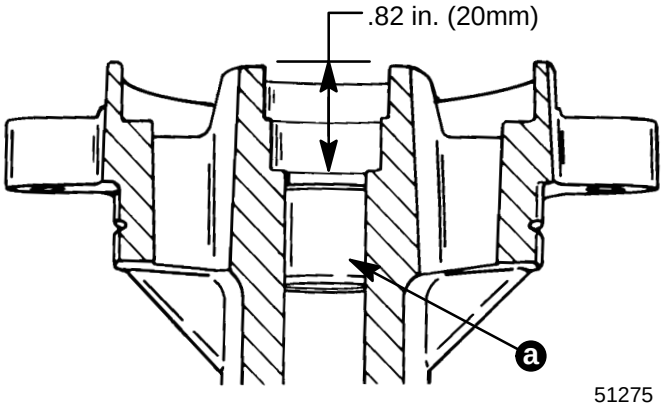


51263

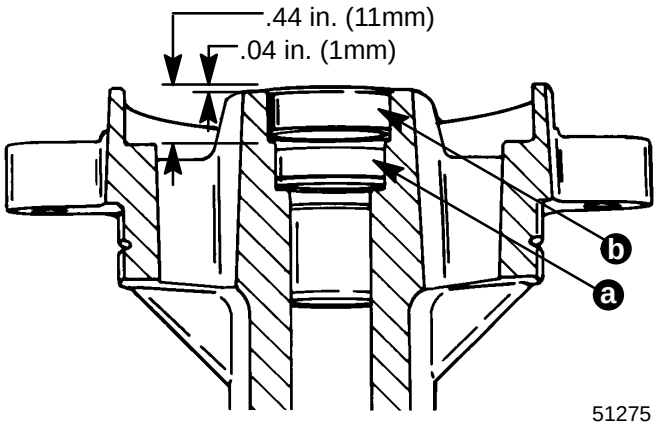
A Loctite Grade A (O.D. of Seal)

a - Large Diameter Seal
b - Installer Tool (91-817007)

Installation Note: If service tools are not available, the following reference dimensions apply for installing bearing and seals to proper depths.

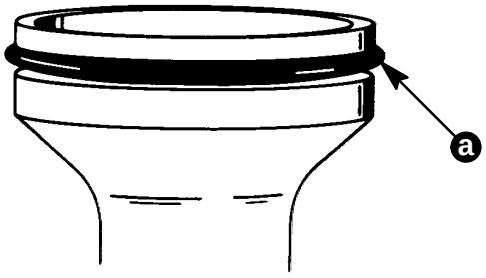


a - Bearing



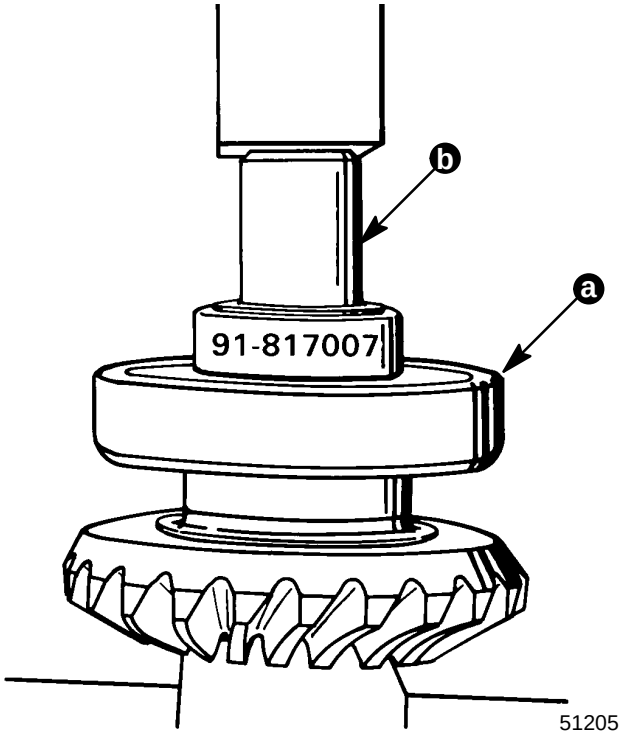
a - Oil Seal (Install with Lip Down)
b - Oil Seal (Install with Lip Up)

5. Lubricate O-ring with Special Lubricant 101. Install O-ring (a).



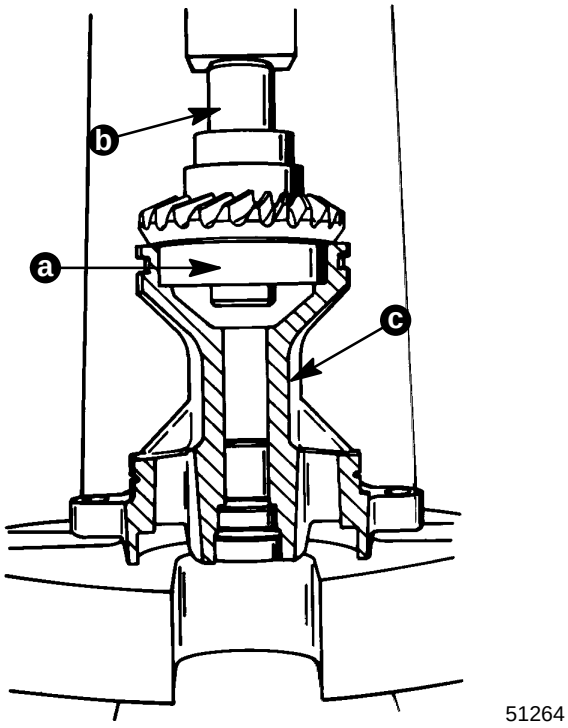
Reverse Gear

1. Lubricate I.D. of bearing (a) with Quicksilver Needle Bearing Assembly Lubricant. Use Installer Tool and press onto gear until bearing bottoms.



a - Bearing
b - Installer Tool (91-817007)

2. Install reverse gear and bearing assembly (a). Lubricate O.D. of bearing with Quicksilver Needle Bearing Assembly Lubricant before installation.

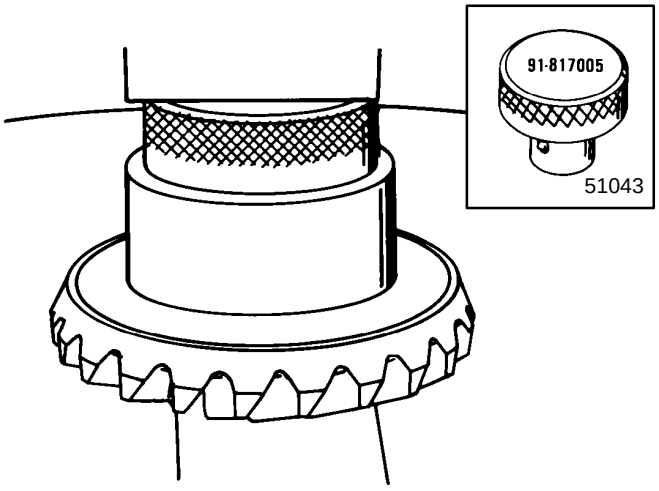


a - Reverse Gear and Bearing Assembly
b - Installer Tool (91-817007)
c - Bearing Carrier

Forward Gear

Press new propshaft bearing into gear. Lubricate O.D. of bearing with Quicksilver Needle Bearing Assembly Lubricant before installation. Press until Installer Tool bottoms.

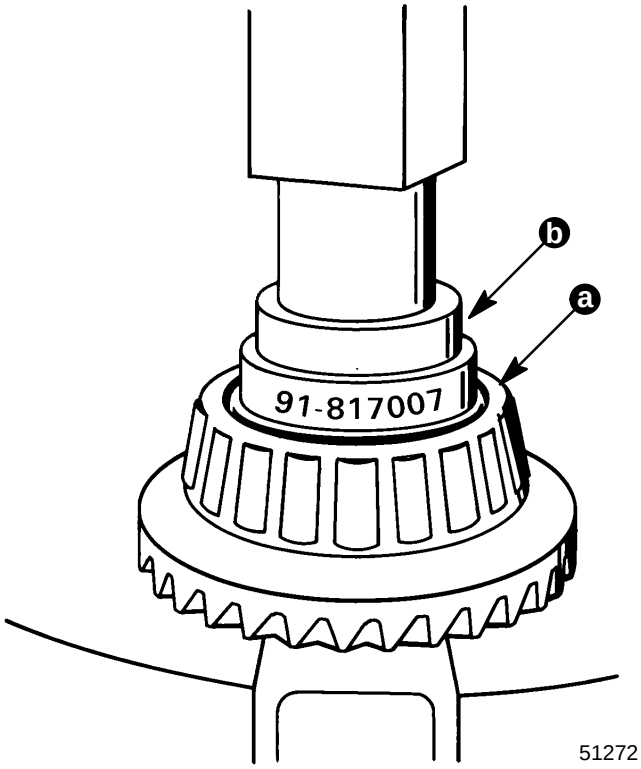
Installation Note: Push against numbered end of bearing.



51291

a - Installer Tool (91-817005)

1. Press tapered roller bearing (a) onto gear. Lubricate I.D. of bearing with Quicksilver Needle Bearing Assembly Lubricant before installation. Use Installer Tool (b). Press until bearing bottoms on gear.



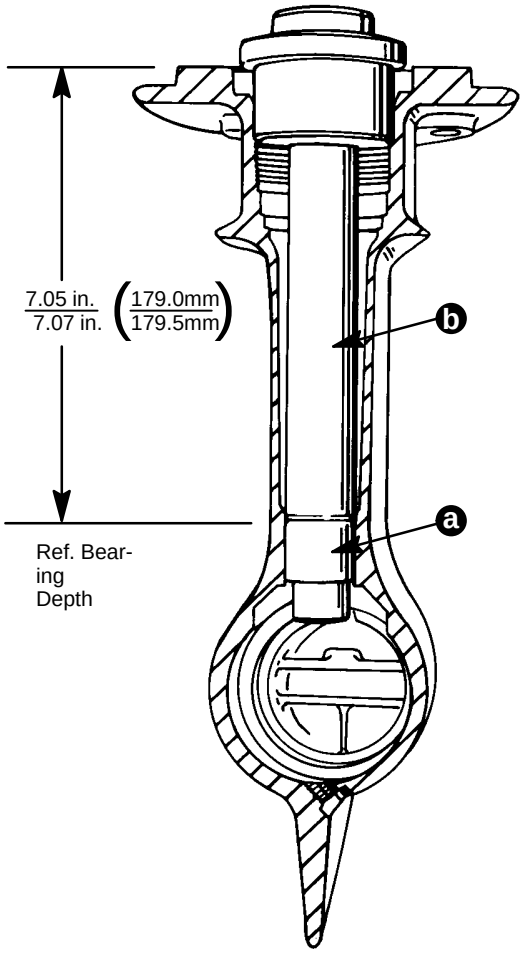
51272

a - Bearing (Lubricate I.D. Before Assembly)
b - Installer Tool (91-817007)

Lower Driveshaft Bearing Installation

1. Lubricate O.D. of bearing race with Quicksilver Needle Bearing Assembly Lubricant.
2. Install bearing (a) into housing. Press until Installer Tool bottoms.

Installation Note: Push against numbered end of bearing.

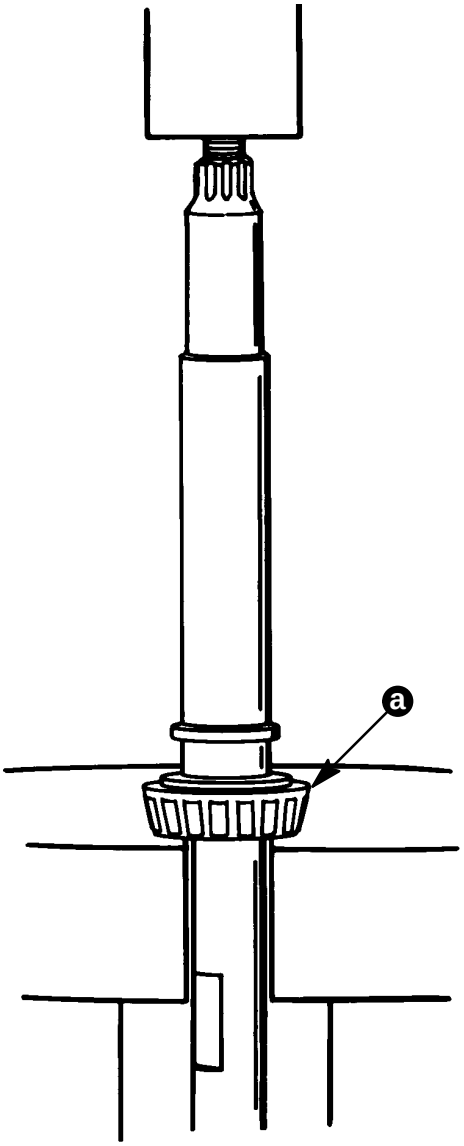


51260

a - Needle Bearing (Lubricate O.D. Before Assembly)
b - Bearing Installer Tool (91-817058A1)

Upper Driveshaft Bearing Installation

1. Press upper driveshaft bearing (a) onto driveshaft. Lubricate I.D. of bearing with Quicksilver Needle Bearing Assembly Lubricant before pressing in place.



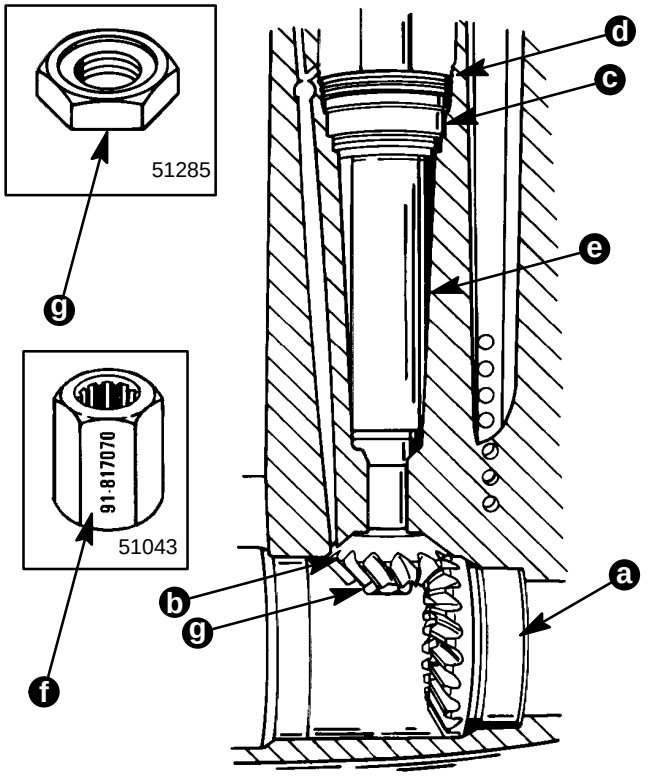
51268

a - Upper Driveshaft Bearing (Lubricate I.D. Before Assembly)

Forward Gear, Pinion Gear, Upper Driveshaft Bearing Race, Retainer and Driveshaft Installation

NOTE: *If shim(s) were lost or are not reusable (damaged), start with approximately .015 in. (0.361mm).*

Install components in sequence shown.



51263

a - Forward Gear/Bearing: Apply Quicksilver Gear Lube to Bearing Rollers Before Installation
b - Pinion Gear
c - Upper Driveshaft Bearing Race and Shim(s)
d - Upper Driveshaft Bearing Retainer [Torque to 75 lb. ft. (101.7 N·m)] Use Tool (91-43506)
e - Driveshaft
f - Driveshaft Holding Tool (91-817070)
g - Pinion Nut (New) (See Note at “Pinion Gear Depth”, Following.) Recess in Nut is Installed Toward Pinion Gear (See Inset).

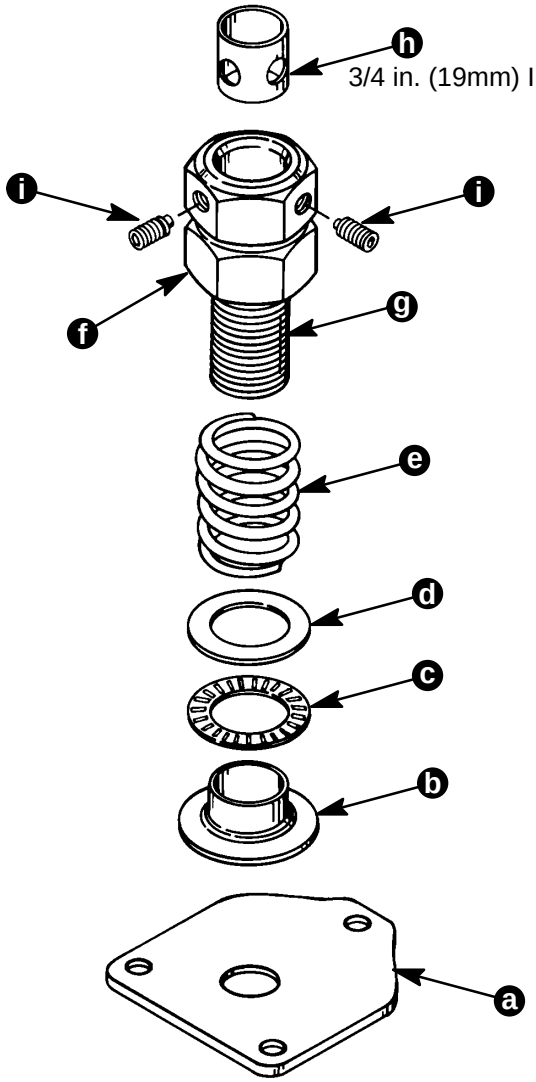
Pinion Gear Location and Forward Gear Backlash

DETERMINING PINION GEAR LOCATION

NOTE: *Read entire procedure before attempting any change in shim thickness.*

IMPORTANT: Forward gear assembly must be installed in gear housing when checking pinion gear depth to obtain accurate shim measurements.

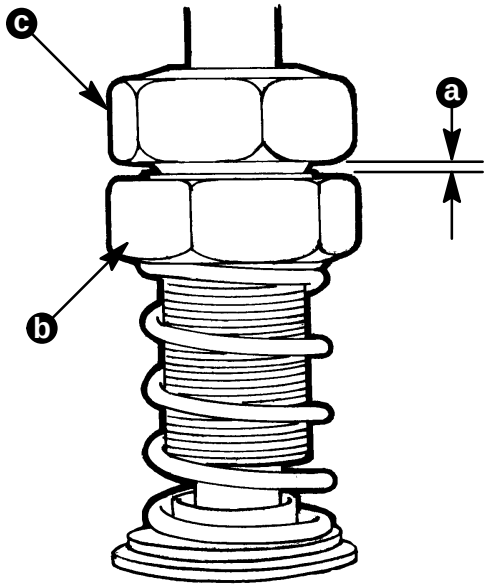
1. Clean the gear housing bearing carrier shoulder and diameter.
2. Position gear housing upright (driveshaft vertical). Install Bearing Preload Tool in sequence shown.



51270

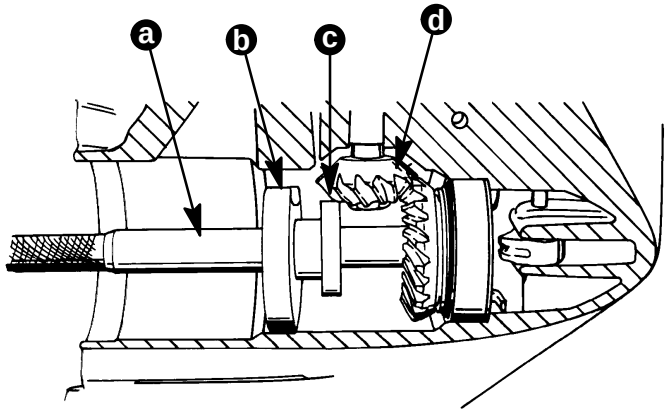
a - Plate
b - Adaptor: Bearing surfaces clean and free of nicks
c - Thrust Bearing: Oiled and able to move freely
d - Thrust Washer: Clean and free of nicks and bends
e - Spring
f - Nut: Threaded all-the-way onto bolt
g - Bolt: Held snug against spring
h - Sleeve: Holes in sleeve must align with set screws
i - Set Screw (2): Tighten against drive shaft, bolt should not slide on driveshaft

3. Measure distance (a).
4. Increase distance (a) by 1 in. (25.4mm).
5. Rotate driveshaft 10 revolutions. This properly seats upper driveshaft tapered roller bearing.



19884

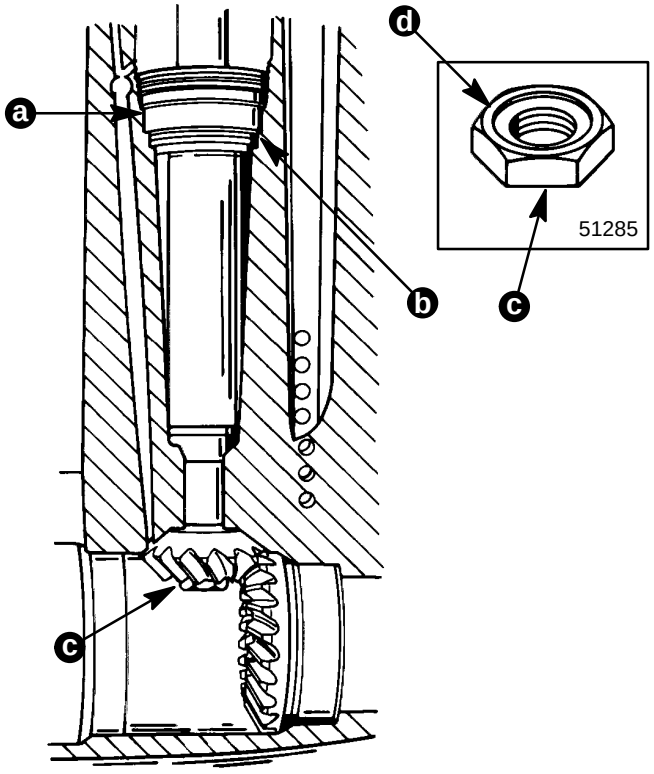
6. Insert Pinion Location Tool (a). Position access hole (b) as shown. Insert feeler gauge between gauging surface (c) and pinion gear (d).



51265

a - Pinion Location Tool (91-817008A2)
b - Access Hole
c - Gauging Surface
d - Pinion Gear

7. The correct clearance between the gauging surface (b) and the pinion gear (c) is .025 in. (0.64mm).
8. To obtain .025 in. (0.64mm), add or subtract shims below the upper bearing race (b) to lower or raise the pinion gear.
9. After final adjustment to pinion height, **and forward gear backlash has been established,** apply Loctite 271 to threads and torque new pinion nut to 50 lb. ft. (67 N·m).



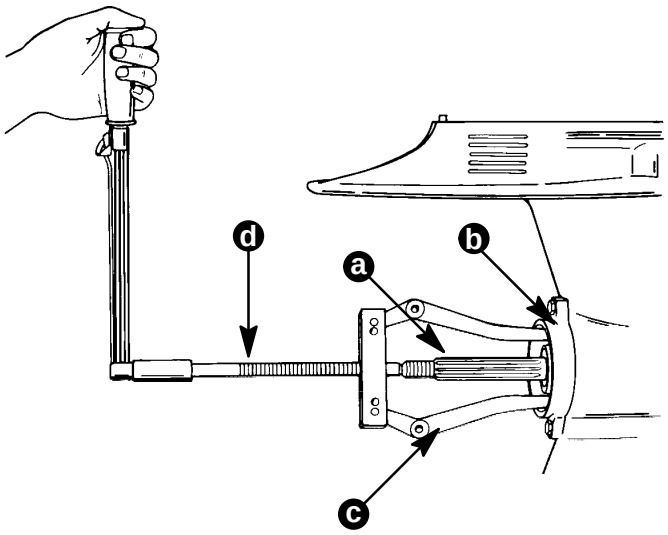
51263

a - Bearing Race
b - Shim(s)
c - Pinion Nut [Recessed Side (d) Toward Pinion]
d - Recessed Side Toward Pinion

DETERMINING FORWARD GEAR BACKLASH

NOTE: *Read entire procedure before attempting any change in shim thickness.*

1. Obtain correct pinion gear location; refer to "Determining Pinion Gear Location", preceding.
2. Install Bearing Preload Tool on driveshaft; refer to "Determining Pinion Gear Location", preceding.
3. Install components.
4. Torque to 45 lb. in. (5 N·m)



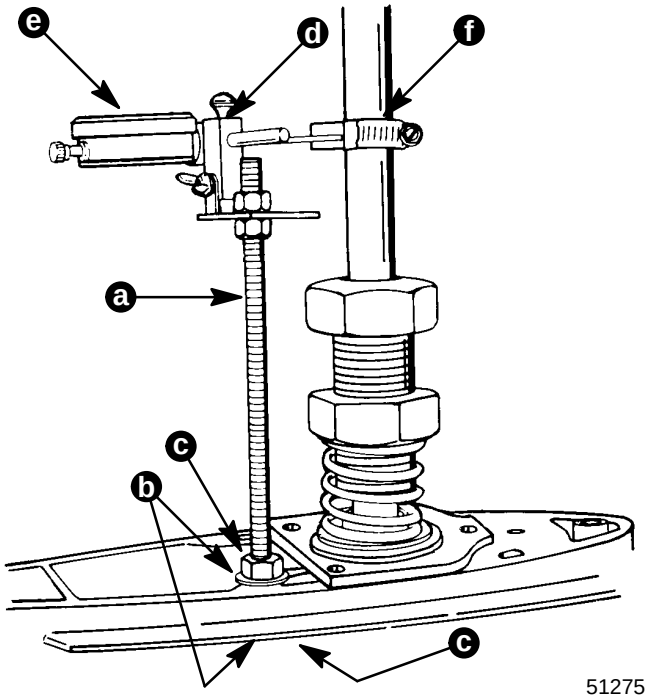
51119

a - Propeller Shaft*
b - Bearing Carrier* (Assembled)
c - Puller Jaws (91-46086A1)
d - Puller Bolt (91-58716) Torque to 45 lb. in. (5.1 N·m).

*Refer to "Bearing Carrier and Propeller Shaft Installation", following.

5. Rotate driveshaft 10 revolutions to properly seat forward gear tapered roller bearing.
6. Re-torque puller bolt to 45 lb. in. (5.1 N·m).

7. Install components.



51275

a - Threaded Rod
b - Washers
c - Nuts
d - Dial Indicator Adaptor Kit (91-83155)
e - Dial Indicator (91-58222A1)
f - Backlash Indicator Tool (91-19660--1)

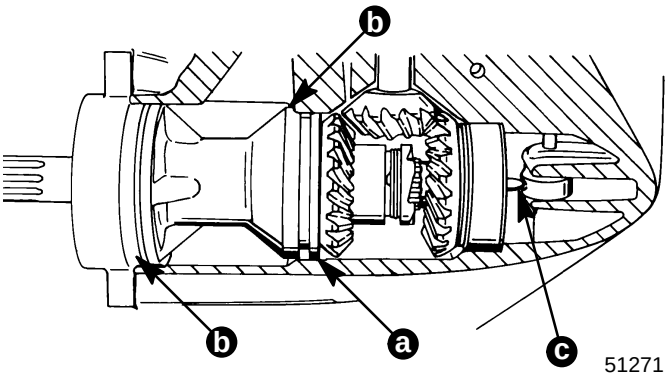
8. Position Dial Indicator on line “3” on Backlash Indicator Tool.
9. Turn driveshaft back-and-forth (check for no rotation at the propeller shaft).
10. Dial Indicator registers amount of backlash, which must be between .013 in. (.33mm) and .019 in. (.48mm).
11. If backlash is less than the minimum reading, remove shim(s)* from in front of the forward gear bearing race.
12. If backlash is more than the maximum reading, add shim(s) in front of the forward gear bearing race.

* By adding or subtracting .001 in. (0.025mm) shim, the backlash will change .00125 in. (0.032mm).

NOTE: *When final measurement has been made, apply Loctite 271 to threads of pinion nut. Torque to 50 lb. ft. (67.8 N·m).*

Bearing Carrier and Propeller Shaft Installation

1. Insert propeller shaft assembly into bearing carrier.
2. Lubricate O-ring (a) and areas (b) with Quicksilver Special Lubricant 101 (P/N 92-13872A1).
3. Install bearing carrier and propeller shaft assembly into gear housing. Use care not to displace cam follower (c).

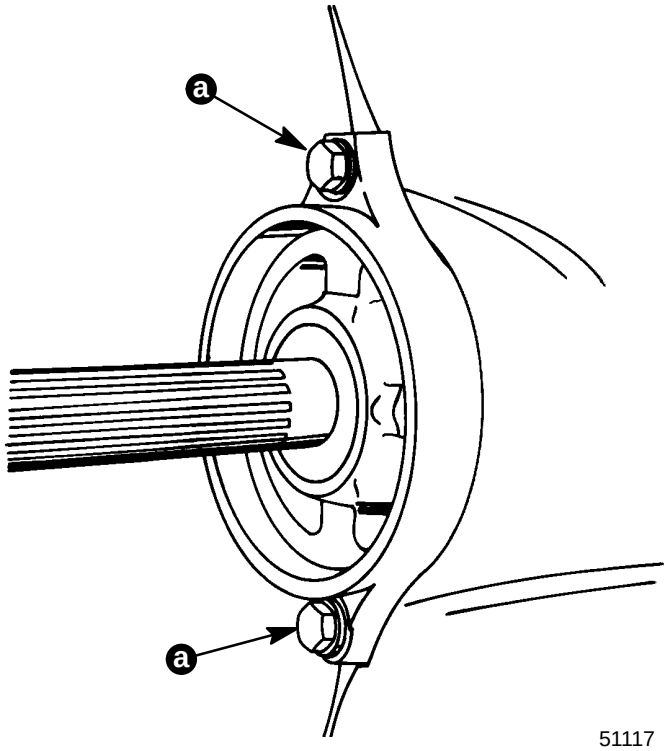


51271

⚠ CAUTION

Use care not to damage O-ring (a) during installation of bearing carrier assembly.

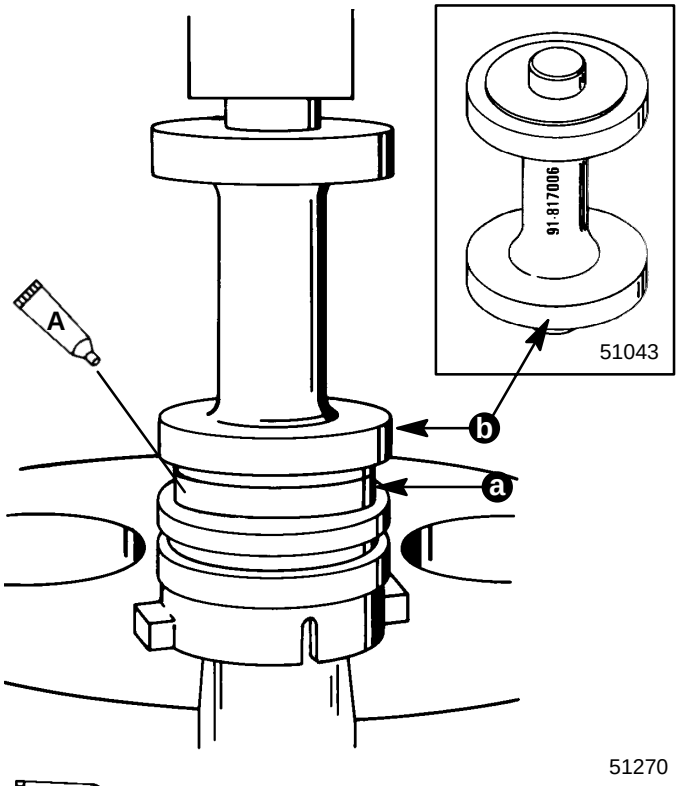
4. Install bolts (a). Apply Loctite 271 to threads and torque to 150 lb. in. (17 N·m).



51117

Water Pump Re-assembly and Installation

1. Place seal (a) on longer shoulder side (b) of tool.
2. Press into water pump base until tool bottoms.



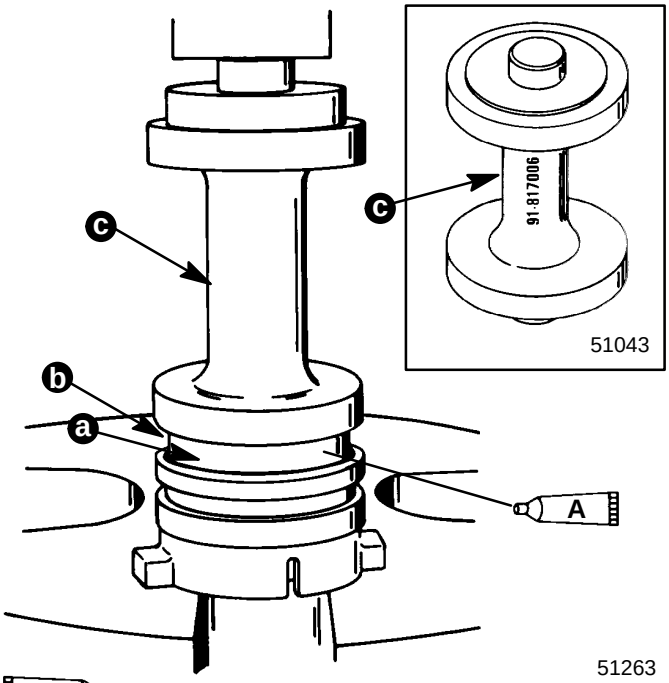
51043

51270

A Quicksilver Gear Lubricant

a - Seal (Install with spring visible when installed.)
b - Seal Installation Tool (91-817006)

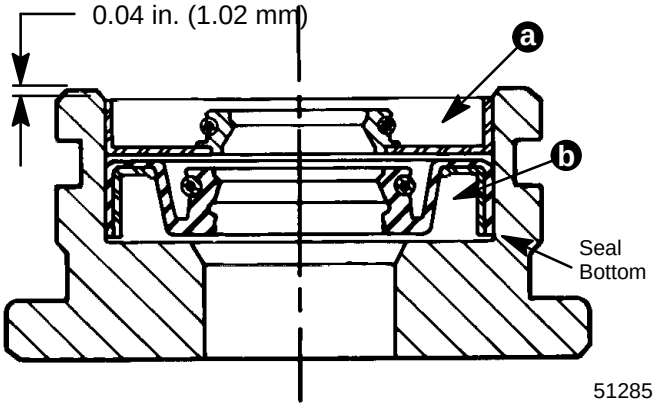
3. Place seal (a) on shorter side (b) of tool (c).
4. Press into water pump base until tool bottoms.



51043

51263

A Quicksilver Gear Lubricant

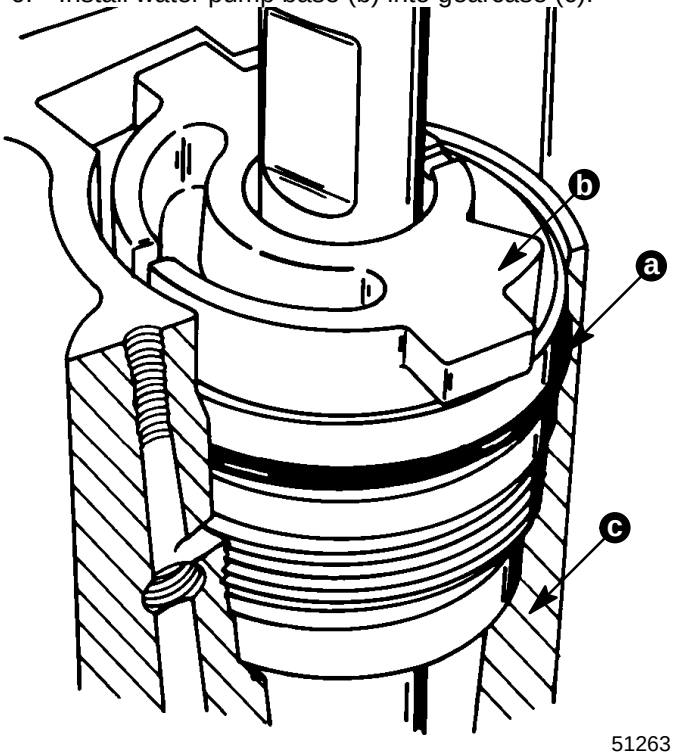


51285

a - Seal (Install with spring visible when installed.)
b - Seal (Install with spring visible when installed.)

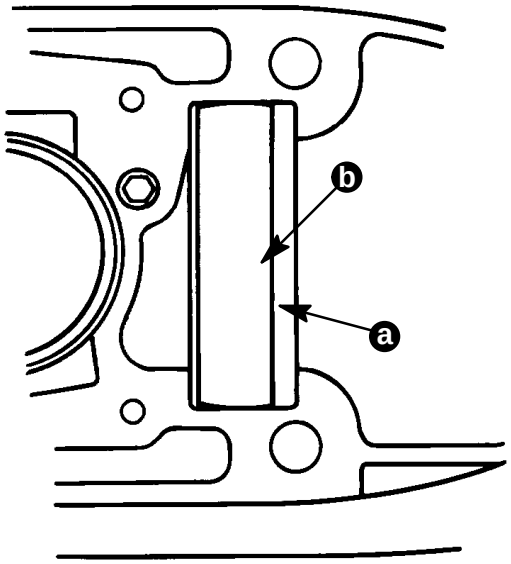
If installation tool is not available, press seals in as shown to depths indicated.

5. Install O-ring (a). Lubricate O-ring and gear housing bore with Quicksilver Special Lubricant 101.
6. Install water pump base (b) into gearcase (c).



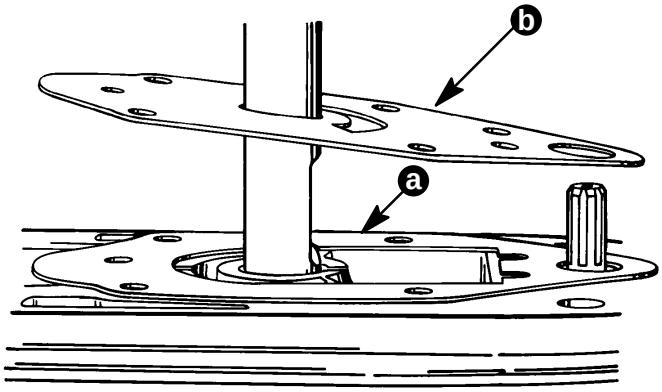
51263

7. If removed previously, re-install seal (a) and plate (b).



51268

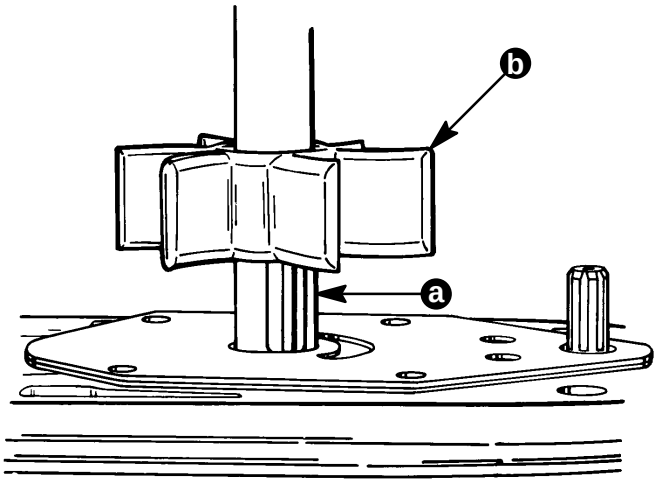
8. Install gasket (a) and face plate (b).



51293

IMPORTANT: If the old impeller is re-used, install in the original (clockwise) direction of rotation.

9. Install drive key (a) and impeller (b).



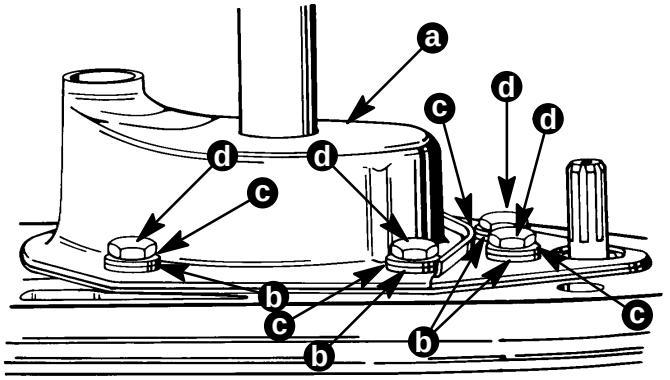
51292

10. Lubricate I.D. of cover with Quicksilver Needle Bearing Assembly Lubricant (P/N 92-42649A1). Install gasket (a) with bead (b) towards cover.



51290

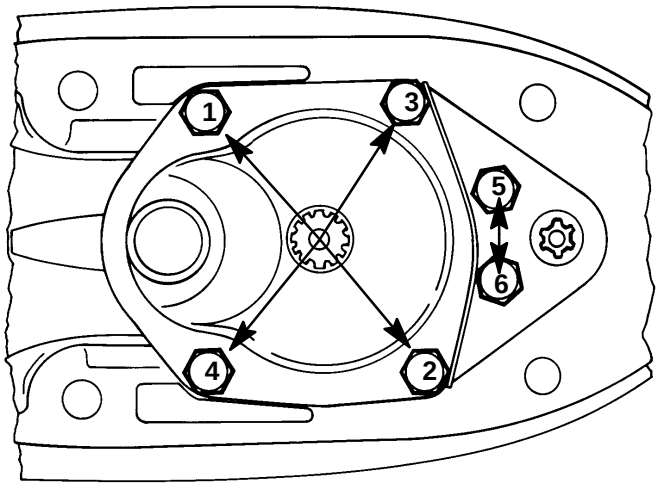
11. Rotate driveshaft clockwise and push cover down. Secure cover.



51275

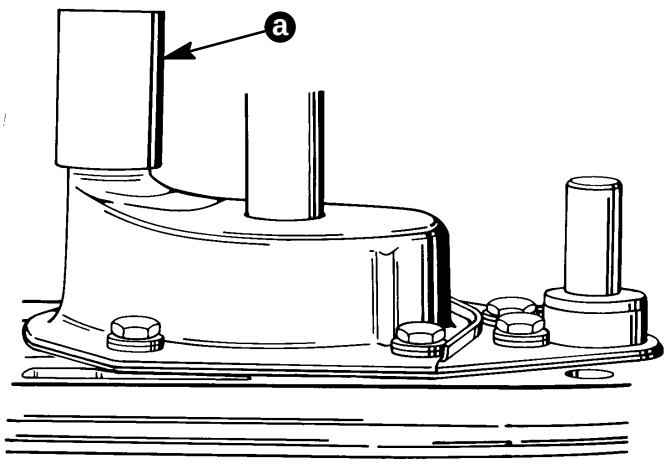
a - Cover
b - Isolators, (Design 1) Note: 2 isolators for forward screws are different from remaining 4 isolators
c - Washers (6)
d - Bolts (6); Apply Loctite on threads and torque to 60 lb. in. (6.8 N·m).

NOTE: *Torque cover screws as shown.*



51271

12. If water tube seal (a) stayed on water tube (inside of driveshaft) pull seal from water tube.
13. Lubricate I.D. of water tube seal (a) with Quicksilver 2-4-C Marine Lubricant (P/N 92-90018A12) and install.

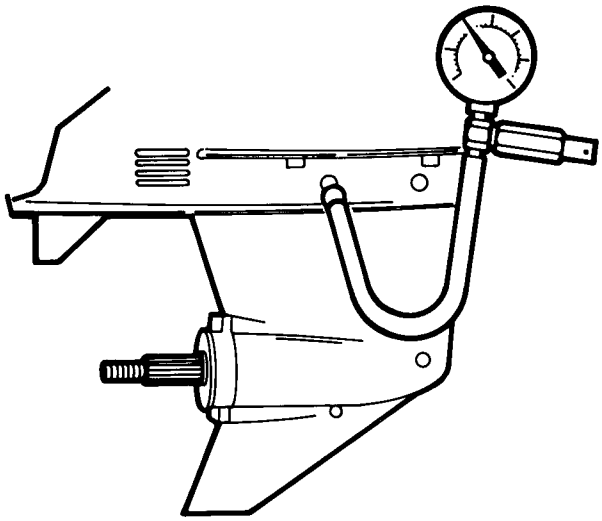


51206

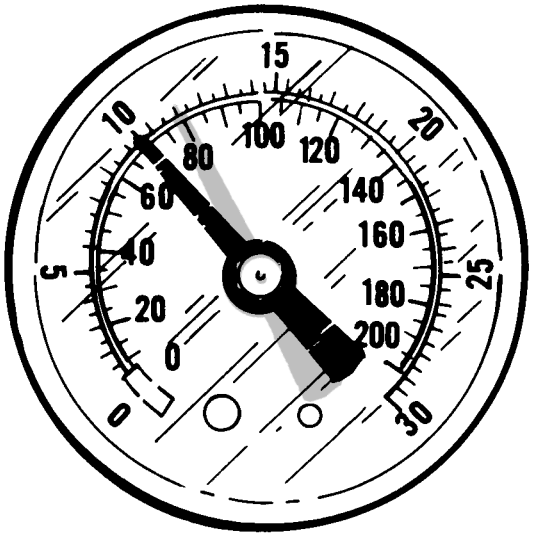
a - Water Tube Seal

Gear Housing Pressure Test

1. Remove vent plug and install pressure test gauge. Tighten securely.



2. Pressurize housing to 10-12 p.s.i. and observe gauge for 5 minutes.
3. Rotate driveshaft, prop shaft and move shift rod while housing is pressurized to check for leaks.



4. If pressure drop is noted immerse housing in water.
5. Re-pressurize to 10-12 p.s.i. and check for air bubbles.
6. Replace leaking seals as necessary. Retest housing.

NOTE: *It should hold 10-12 p.s.i. for 5 minutes.*

7. Remove tester from housing and install vent plug.

Gear Housing Installation

Filling Gear Housing with Lubricant

NOTE: *Gear housing lubricant capacity is approximately 11.5 fl. oz. (340 ml).*

⚠ WARNING

If gear housing is installed on outboard, disconnect (and isolate) spark plug leads from spark plugs before working near the propeller.

⚠ CAUTION

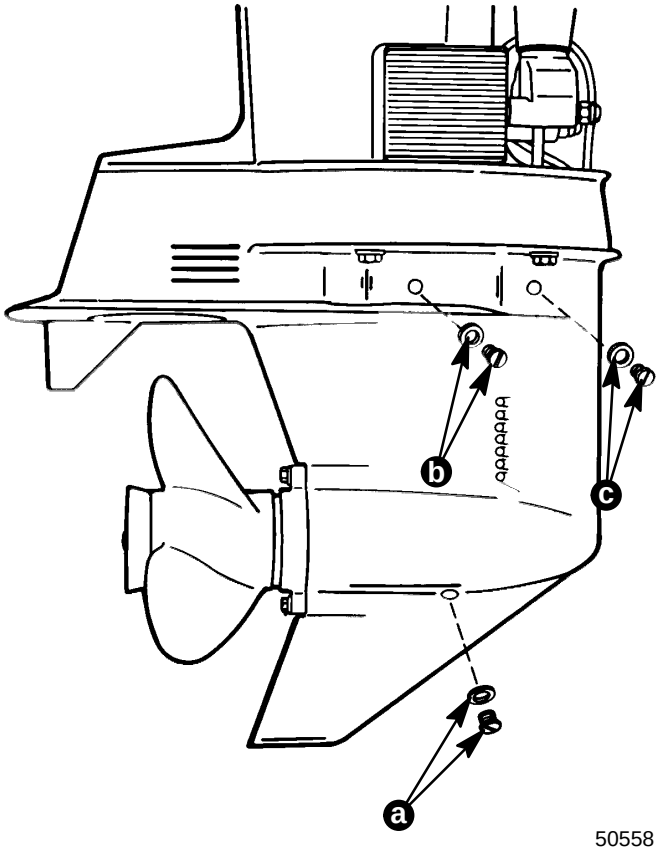
Do not use automotive grease in the gear housing. Use only Quicksilver Gear Lube.

1. Remove any gasket material from “Fill” and “Vent” plugs and gear housing. Install new gaskets on “Fill” and “Vent” plugs.

IMPORTANT: Never add lubricant without removing “Vent” plugs. Gear housing cannot be filled because of trapped air. Fill gear housing when driveshaft is in a vertical position.

2. Remove “Fill” plug and gasket (a).

3. Insert lubricant tube in “Fill” hole, then remove “Vent” plugs and gaskets (b and c).
4. Fill until excess lubricant flows out of “Vent” hole (b).
5. Replace this “Vent” plug and gasket and continue to fill until lubricant flows from second “Vent” hole (c).
6. Replace this “Vent” plug and gasket (c).
7. Install “Fill” plug and gasket (a).



50558

a - “Fill” Plug
b - “Vent” Plug
c - “Vent” Plug

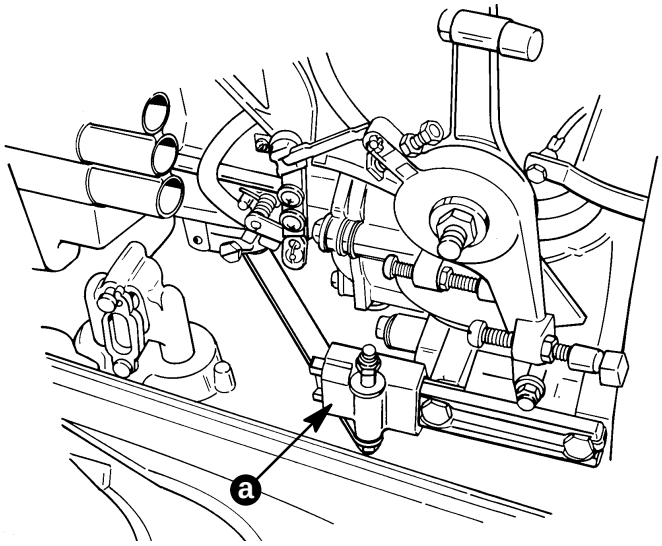
Torque screws to 35-80 lb. in. (3.8-8.8 N·m)

Gear Housing Installation

⚠ WARNING

Disconnect (and isolate) spark plug leads before installing gear housing onto driveshaft housing.

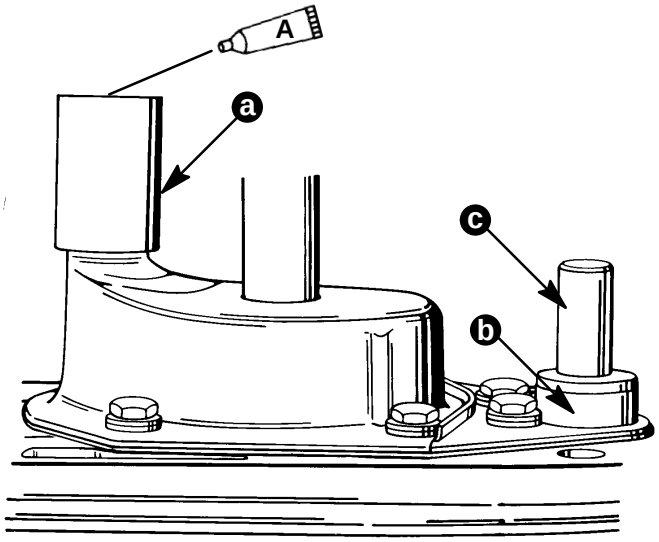
1. Position shift block (a) in forward gear position.



51190

a - Shift Block

2. Tilt engine to full “Up” position. Engage tilt lock lever.
3. Shift gear housing into neutral. Propeller shaft will rotate freely in either direction.
4. Install water tube seal (a), spacer (b) and shift shaft coupler (c).



51206

A — 2-4-C Marine Lubricant (I.D. of seal, coupler splines)

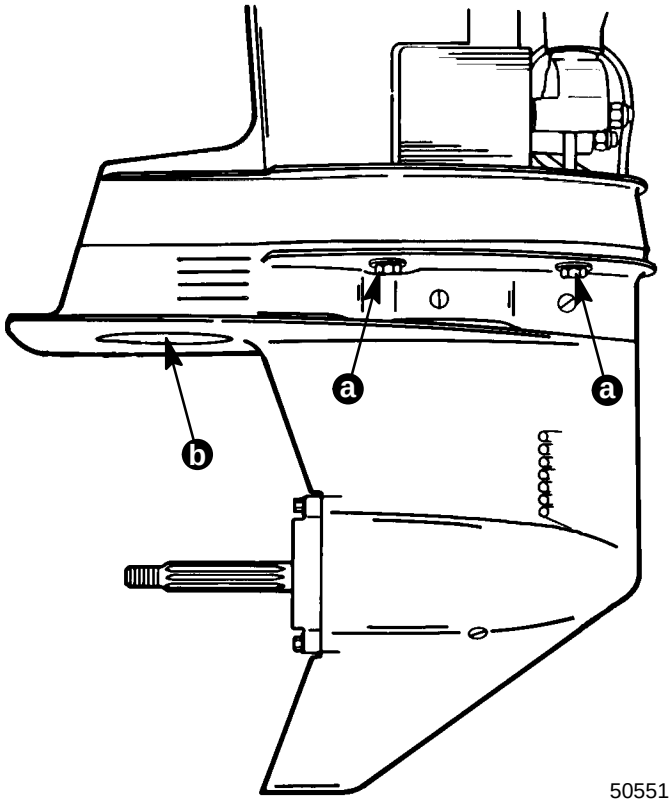
⚠ CAUTION

Do not lubricate top of driveshaft. Excess lubricant will not allow driveshaft to fully engage crankshaft. Tightening the gear housing fasteners (if excess lubricant is on top of driveshaft) will load the driveshaft/crankshaft and may damage either or both powerhead and gear housing. Wipe the top of driveshaft free of lubricant.

5. Lightly apply Quicksilver 2-4-C Marine Lubricant onto the driveshaft splines.
6. Shift gear housing into forward gear. Gear housing will not engage when propeller shaft is turned clockwise.
7. Position driveshaft into driveshaft housing. Move gear housing towards driveshaft housing while aligning shift shaft coupler, water tube seal and driveshaft splines.

NOTE: *If the driveshaft splines will not align with the crankshaft splines, install a propeller and turn the propeller shaft counterclockwise while pushing gear housing onto driveshaft housing. It may also be necessary to move the shift block (on the powerhead) to align the shift shaft splines for proper re-assembly.*

8. Install 4 bolts and washers (a), (two each side). Apply Loctite A (271) on threads of bolts prior to installation.
9. Install locknut and washer (b).
10. Torque bolts and locknut to 40 lb. ft. (54 N·m).



50551

11. Check shift operation.
    a. Gear housing should not engage when propeller shaft is turned clockwise when in forward gear.
    b. Propeller shaft will rotate freely in either direction when gearcase is in neutral.
    c. Propeller shaft will not rotate in either direction when gearcase is in reverse.

IMPORTANT: If shift operation is not as described, remove the gear housing and correct the shift operation.

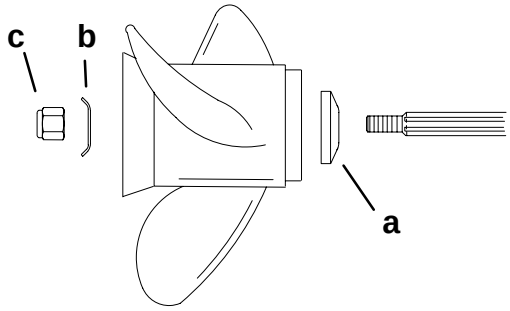
Propeller Installation

⚠ WARNING

Disconnect and isolate spark plug leads when working near the propeller to prevent the outboard from starting.

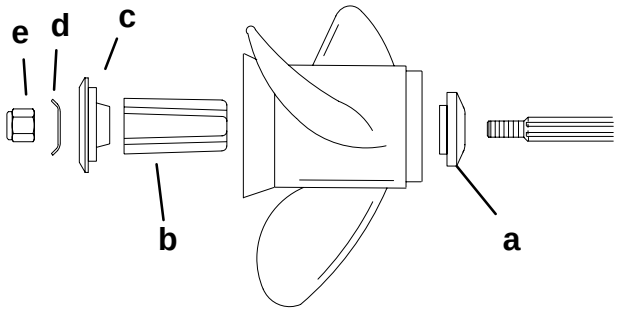
1. Apply a thin coat of lubricant to propeller shaft splines with Quicksilver 2-4-C Marine Lubricant.
2. Install components as shown.

Flo-Torq I Drive Hub Propellers



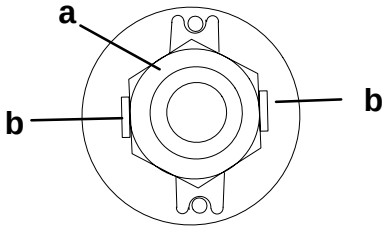
a - Forward Thrust Hub
b - Propeller Nut Retainer
c - Propeller Nut

Flo-Torq II Drive Hub Propellers



a - Forward Thrust Hub
b - Replaceable Drive Sleeve
c - Rear Thrust Hub
d - Propeller Nut Retainer
e - Propeller Nut

3. Tighten propeller nut to 55 lb.ft. (75 N·m). Bend tabs against nut.



a - Propeller Nut - Torque To 55 lb. ft. (75 N·n)
b - Bend Tabs Against Nut

⚠ CAUTION

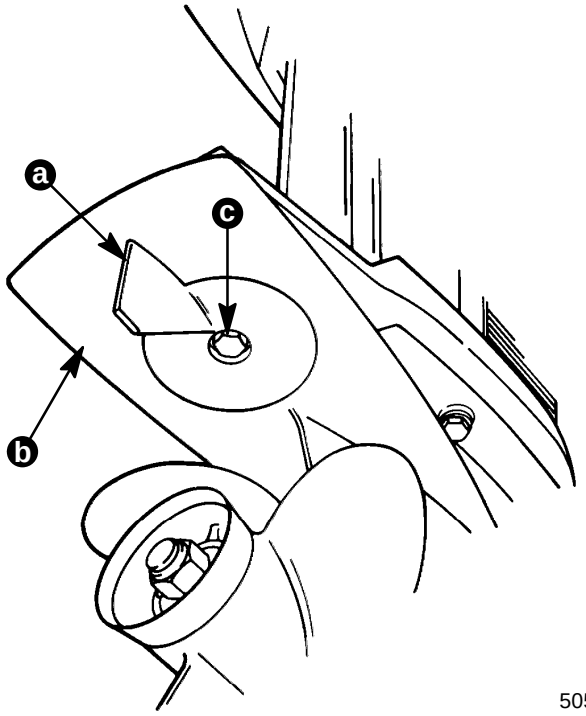
Do not misinterpret propeller shaft movement for propeller movement, propeller and propeller shaft however may move fore-and-aft. However, the propeller itself should not move fore-and-aft on the propeller shaft.

4. Re-check propeller nut for tightness after first use. Check for tightness periodically, especially if a stainless propeller is used.
5. Install and adjust trim tab as follows.

Trim Tab Adjustment and Replacement

IMPORTANT: The trim tab is made of a special alloy to aid in protecting the drive shaft housing and gear housing from galvanic corrosion (corrosion and pitting of metal surfaces). Do not paint or place protective coating on the trim tab, or trim tab corrosion protection function will be lost.

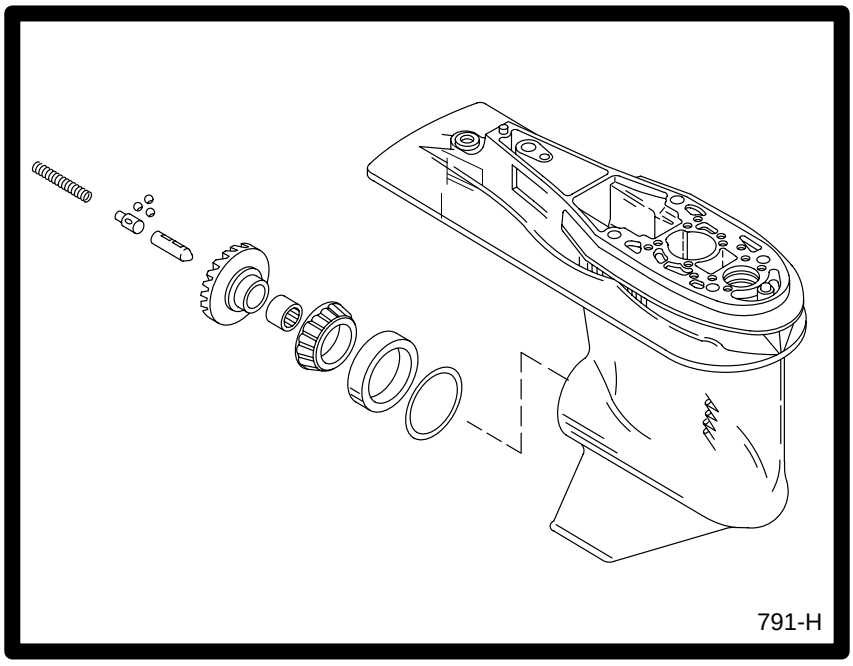
1. Replace trim tab if 50% (or more) consumed. Mark location of old trim tab on anti-ventilation plate before removal; install new trim tab in same location.
2. The trim tab will offset (balance) some of the “steering load” that is caused by “propeller torque” at higher speeds. If at higher speeds the boat turns more easily to the left, loosen bolt, move the trim tab (trailing edge) to the left (when viewed from behind); re-tighten bolt. Turn trim tab (trailing edge) to the right if the boat turns more easily to the right.



50553

a - Trim Tab
b - Anti-Ventilation Plate
c - Retaining Bolt and Washer; Torque Bolt to 22 lbs. ft. (29.8 N·m)

LOWER UNIT



60 BIG FOOT,
60 SEAPRO/MARATHON
GEAR HOUSING
(4-1/4 inch Torpedo, 2.3:1 Gear Ratio)

6

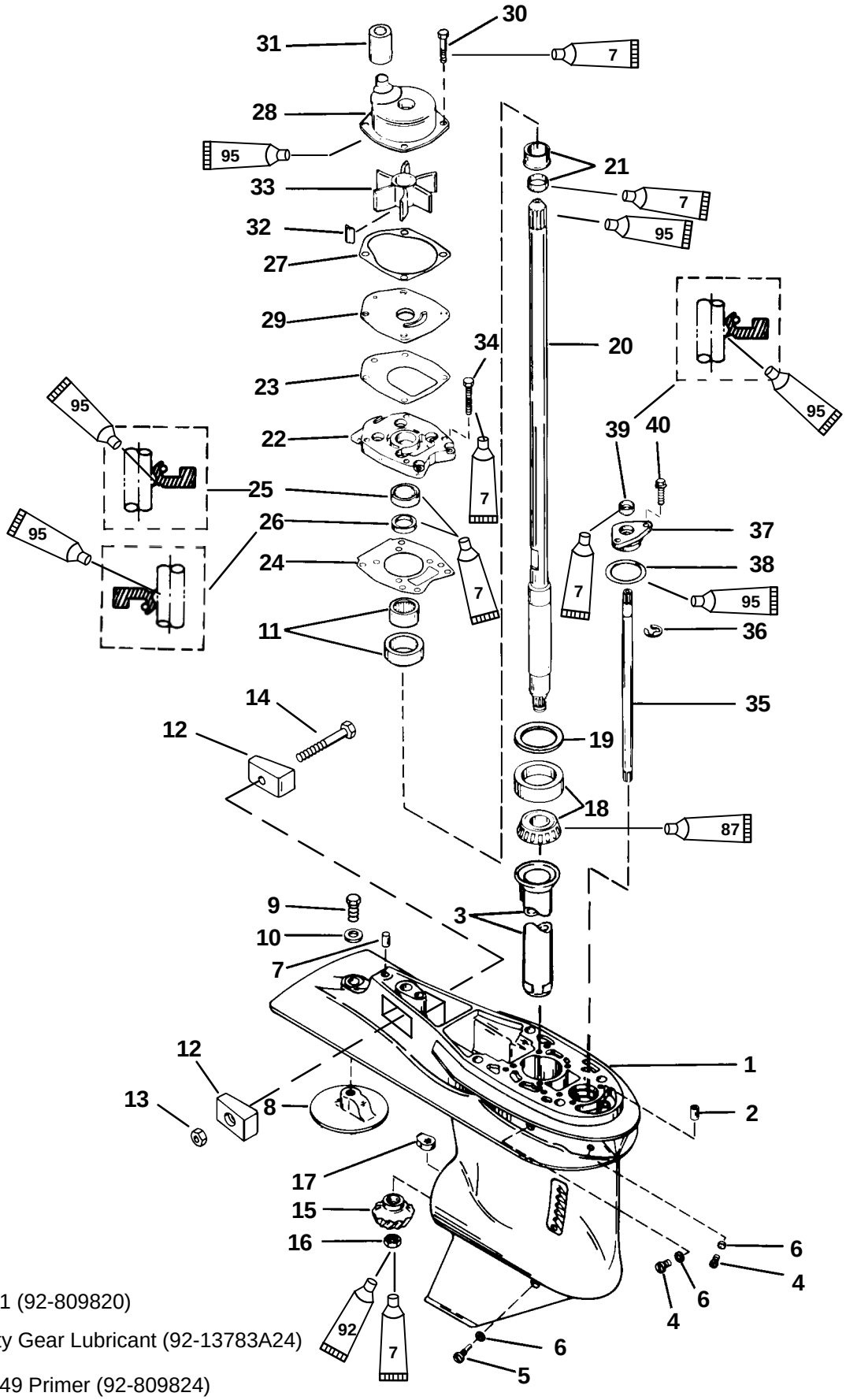
B

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Notes:

Gear Hsg. (Drive Shaft)(60 Seapro/Marathon/Big Foot)



7 Loctite 271 (92-809820)

87 Super Duty Gear Lubricant (92-13783A24)

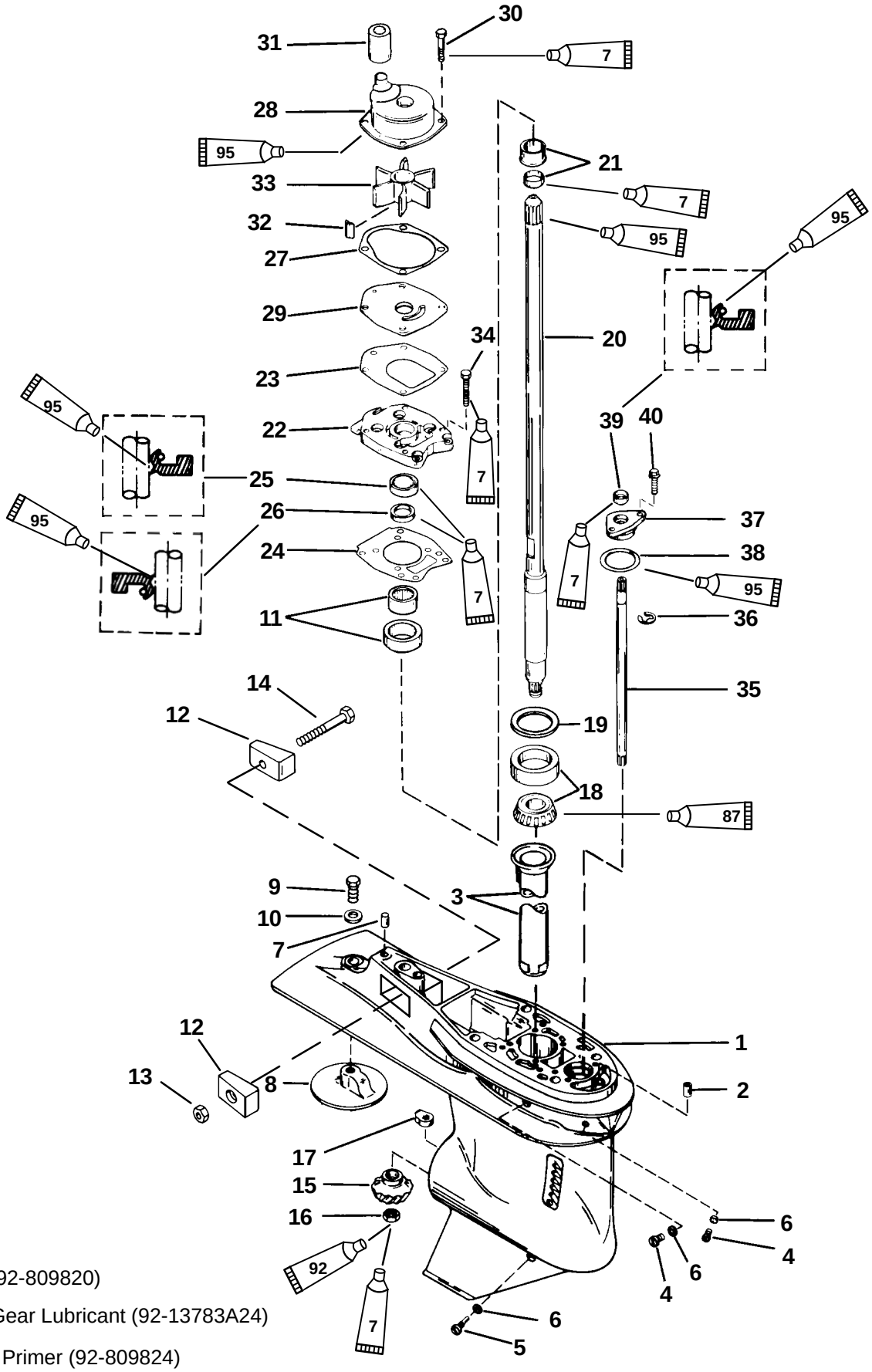
92 Loctite 7649 Primer (92-809824)

95 2-4-C With Teflon (92-825407A12)

Gear Hsg. (Drive Shaft)(60 Seapro/Marathon/Big Foot)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
–	1	GEAR HOUSING **(LONG)**			
1	1	GEAR HOUSING ASSEMBLY			
2	1	DOWEL PIN **(FRONT)**			
3	1	OILER TUBE			
4	2	DRAIN SCREW	60		7.0
5	1	SCREW **(MAGNETIC)**	60		7.0
6	3	WASHER-Sealing			
7	1	DOWEL PIN **(REAR)**			
8	1	TRIM TAB			
9	1	SCREW		22	30.0
10	1	WASHER			
11	1	CARRIER			
12	2	ANODE			
13	1	NUT	60		7.0
14	1	SCREW			
15	1	PINION GEAR			
16	1	NUT		70	95.0
17	1	SHIFT CAM			
18	1	TAPERED ROLLER BEARING			

Gear Hsg. (Drive Shaft) (60 SeaPro/Marathon/Big Foot)



7 Loctite 271 (92-809820)

87 Super Duty Gear Lubricant (92-13783A24)

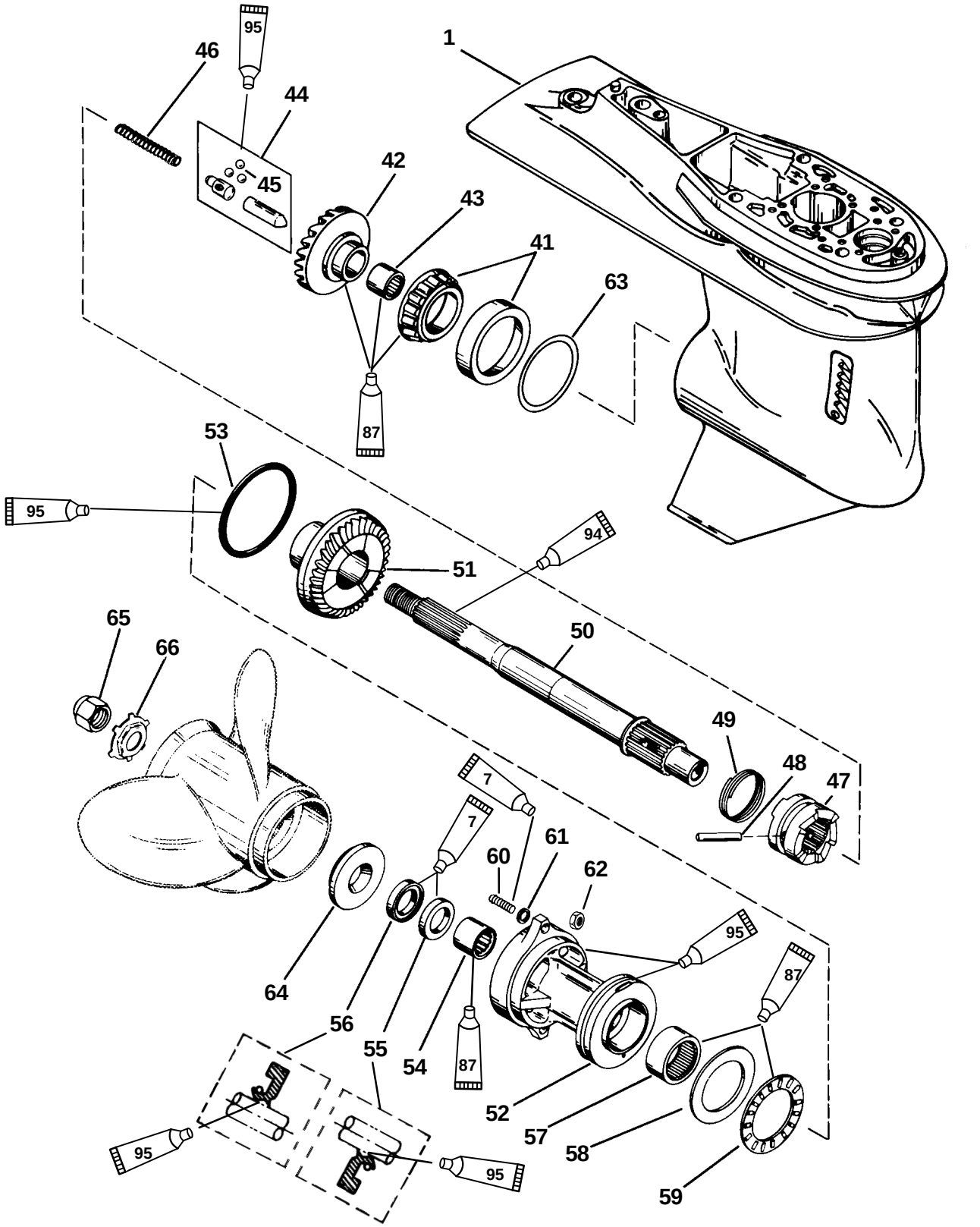
92 Loctite 7649 Primer (92-809824)

95 2-4-C With Teflon (92-825407A12)

Gear Hsg. (Drive Shaft)(60 Seapro/Marathon/Big Foot)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
–	1	GEAR HOUSING			
1	1	GEAR HOUSING ASSEMBLY			
19	1	SHIM ASSEMBLY			
20	1	DRIVE SHAFT ASSEMBLY			
21	1	WEAR SLEEVE ASSEMBLY			
22	1	COVER ASSEMBLY			
23	1	GASKET			
24	1	GASKET			
25	1	OIL SEAL **(LOWER)**			
26	1	OIL SEAL **(UPPER)**			
27	1	GASKET			
28	1	WATER PUMP ASSEMBLY			
29	1	FACE PLATE			
30	4	SCREW (M6 x 1 x 30)	60		7.0
31	1	COUPLING			
32	1	KEY			
33	1	IMPELLER			
34	6	SCREW	60		7.0
35	1	SHIFT SHAFT ASSEMBLY			
36	1	E-RING			
37	1	BUSHING ASSEMBLY			
38	1	O-RING			
39	1	OIL SEAL			
40	2	SCREW (M6 x 1)	35		4.0

Gear Hsg. (Prop Shaft)(60 Seapro/Marathon/Big Foot)



7 Loctite 271 (92-809820)

87 Super Duty Gear Lubricant (92-13783A24)

94 Anti-Corrosion Grease (92-78376A6)

95 2-4-C With Teflon (92-825407A12)

Gear Hsg. (Prop Shaft)(60 Seapro/Marathon/Big Foot)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
–	1	GEAR HOUSING			
1	1	GEAR HOUSING ASSEMBLY			
41	1	TAPERED ROLLER BEARING ASSEMBLY			
42	1	FORWARD GEAR			
43	1	ROLLER BEARING			
44	1	CAM FOLLOWER ASSEMBLY			
45	3	BALL			
46	1	SPRING			
47	1	CLUTCH			
48	1	CROSS PIN			
49	1	SPRING			
50	1	PROPELLER SHAFT			
51	1	REVERSE GEAR			
52	1	BEARING CARRIER ASSEMBLY			
53	1◗	O-RING			
54	1	ROLLER BEARING			
55	1◗	OIL SEAL **(INNER)**			
56	1◗	OIL SEAL **(OUTER)**			
57	1	ROLLER BEARING			
58	1	THRUST WASHER			
59	1	THRUST BEARING			
60	2	STUD			
61	2	WASHER			
62	2	NUT	260	21.5	29.5
63	1	SHIM ASSEMBLY			
64	1	THRUST HUB ASSEMBLY			
65	1	PROPELLER NUT ASSEMBLY		55	74.5
66	1	TAB WASHER			

Special Tools

Part No.	Description
91-46086A1	Puller Jaws
91-85716	Puller Bolt
91-34569A1	Slide Hammer
91-36569	Mandrel*
91-15755	Mandrel*
91-37323	Driver Rod*
91-56775	Drive Shaft Holding Tool
91-37241	Universal Puller Plate
91-83165M	Bearing Puller Assembly
91-31106	Mandrel
91-31108	Oil Seal Driver
91-37350	Mandrel
91-31229	Threaded Rod*
11-24156	Nut*
91-78473	Backlash Indicator Tool (3 Cyl)
91-58222A1	Dial Indicator
91-83155	Dial Indicator Adaptor Kit
91-12349A2	Pinion Gear Locating Tool
91-14308A1	Bearing Race Tool
91-14309A1	Bearing Installation Tool
91-14310A1	Wear Sleeve Installation Tool
91-14311A2	Bearing Preload Tool
91-13945	Bearing Installation Tool
91-13949	Oil Seal Driver
91-19660--1	Backlash Indicator Tool (4 Cyl)

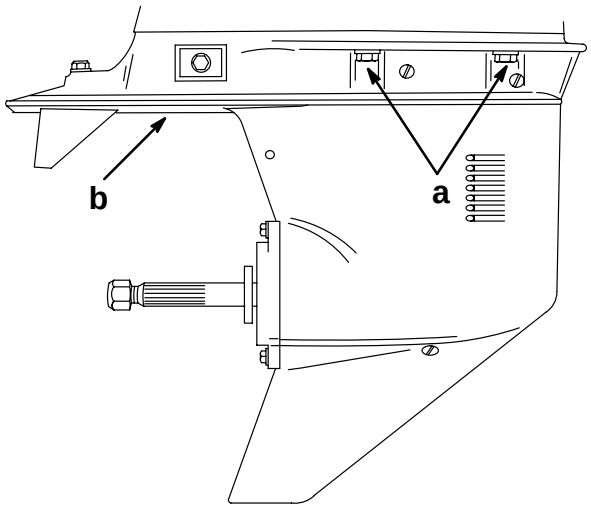
* From Bearing Removal and Installation Kit (91-31229A7)

Removal

⚠ WARNING

To prevent accidental engine starting, remove (and isolate) spark plug leads from spark plugs before removing gear housing.

1. Remove (and isolate) spark plug leads from spark plugs.
2. Shift engine into forward gear.
3. Tilt engine to full “Up” position.
4. Remove 4 bolts (or locknuts on 1995 Models) and washers (two each side).
5. Remove locknut and washer.
6. Remove gear housing.



53992

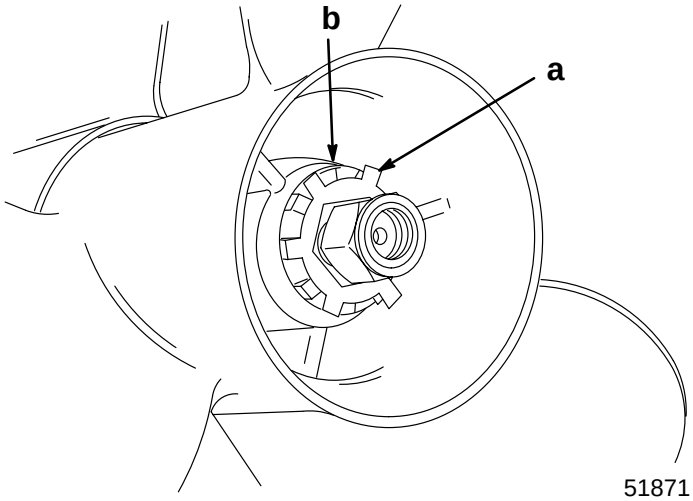
a - Bolts (or Locknuts) and Washers
b - Locknut and Washer

Propeller Removal

⚠ WARNING

If gear housing is not removed from drive shaft housing, before attempting to remove or install the propeller, remove (and isolate) spark plug leads from spark plugs to prevent engine from starting accidentally.

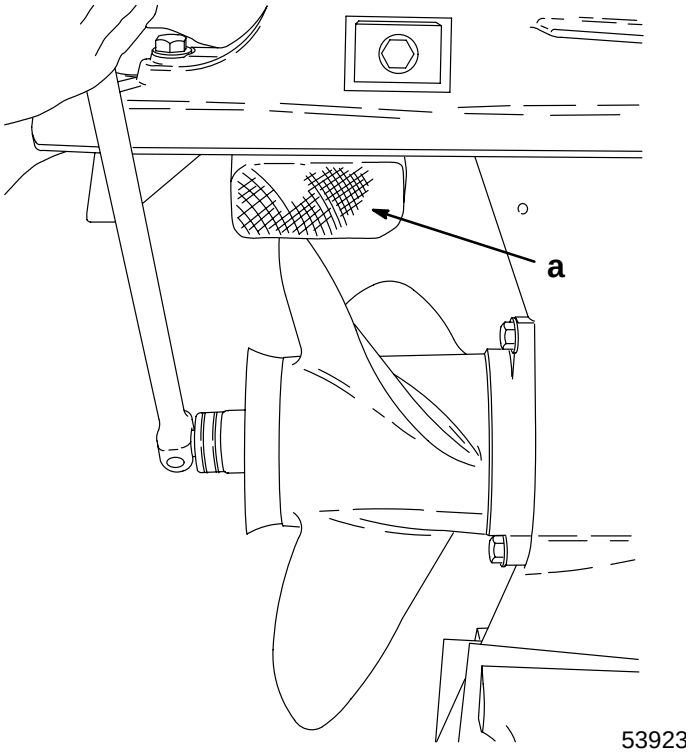
1. Bend tabs of tab washer away from hub.



51871

a - Tab Washer
b - Hub

2. Place a block of wood, as shown, to prevent propeller from rotating and to protect hands during removal of nut.
3. Remove nut and pull components from shaft.



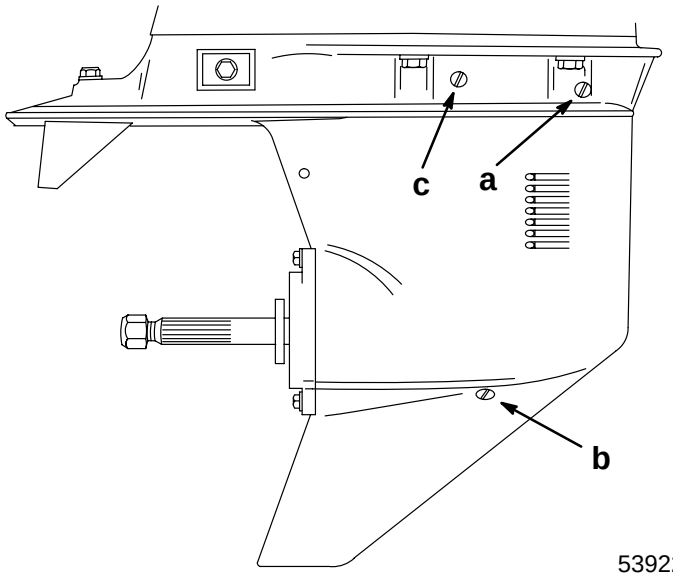
a - Block of Wood

Draining and Inspecting Gear Housing Lubricant

⚠ WARNING

If gear housing is installed on engine, to avoid accidental starting, disconnect (and isolate) spark plug leads from spark plugs before working near the propeller.

1. With gear housing in normal running position, place a clean pan under housing and remove the two vent screws and one fill/drain screw (with gaskets).

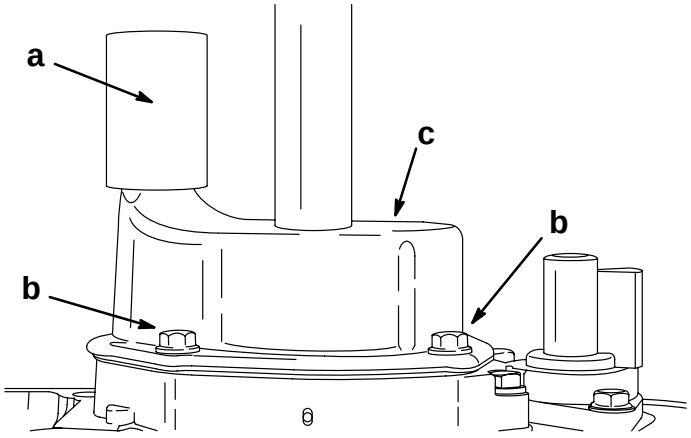


a - Oil Level Screw
b - Fill/Drain Screw
c - Vent Screw

2. Inspect gear lubricant for metal particles (lubricant will have a “metal flake” appearance). Presence of fine metal particles (resembling powder) on the drain plug bar magnet indicates normal wear. The presence of metal chips on the drain plug bar magnet indicates the need for gear housing disassembly and component inspection.
3. Note color of gear lubricant. White or cream color MAY indicate presence of water in lubricant. Gear lubricant which has been drained from a gear case recently in operation will have a yellowish color due to lubricant agitation/aeration. Gear lube which is mixed with assembly lubricant (Special Lube 101 or 2-4-C w/Teflon will also be creamy white in color. This is normal and should not be confused with the presence of water. If water is suspected to be present in gearcase, a pressure check of gearcase should be made (with no lubricant in gearcase). Gearcase should hold 10 to 12 psi of pressure for 5 minutes without leaking down. Pouring a portion of the gear lubricant into a glass jar and allowing the lubricant to settle will allow any water in the lube to separate and settle to the bottom of the jar.
4. Presence of water in gear lubricant indicates the need for disassembly and inspection of oil seals, seal surfaces, O-rings, water pump gaskets as well as gear housing components for damage. If gearcase is rebuilt, gearcase should be pressure checked before filling with lubricant.

Water Pump

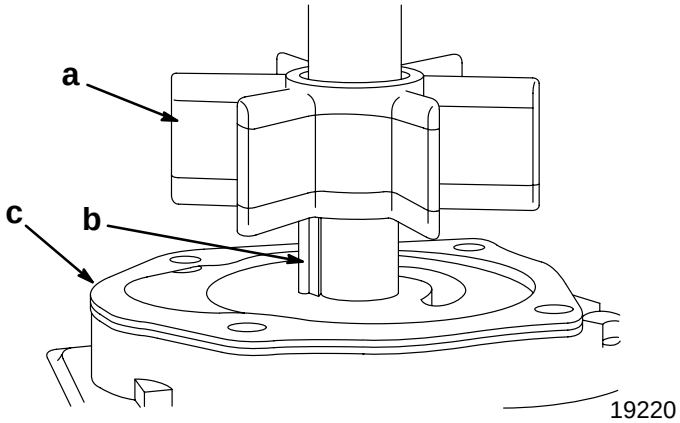
1. If water tube seal stayed on water tube (inside of drive shaft housing) when gear housing was removed, pull water tube seal from water tube.
2. Replace water tube seal, if damaged.
3. Remove 4 bolts, washers, and isolators.
4. Remove cover.



a - Water Tube Seal
b - Bolts (4 each)
c - Cover

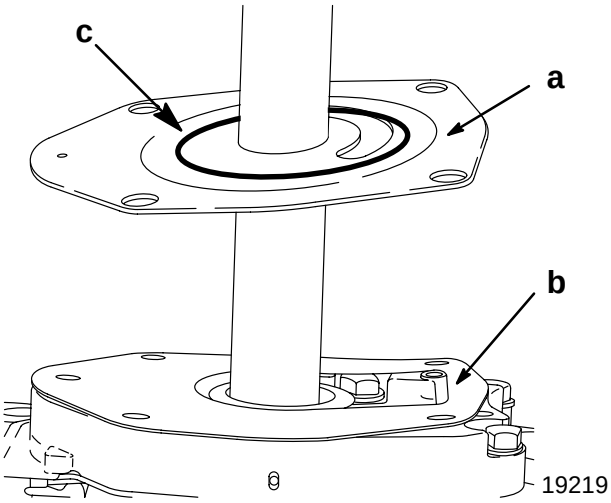
IMPORTANT: The circular groove formed by the impeller sealing bead should be disregarded when inspecting cover (Step 5) and plate (Step 9), as the depth of the groove will not affect water pump output.

5. Replace cover if thickness of steel at the discharge slots is 0.060″ or less, or if groove(s) (other than impeller sealing bead groove) in cover roof are more than 0.030″ (0.762mm) deep.
6. Lift impeller, drive key, and gasket from drive shaft.



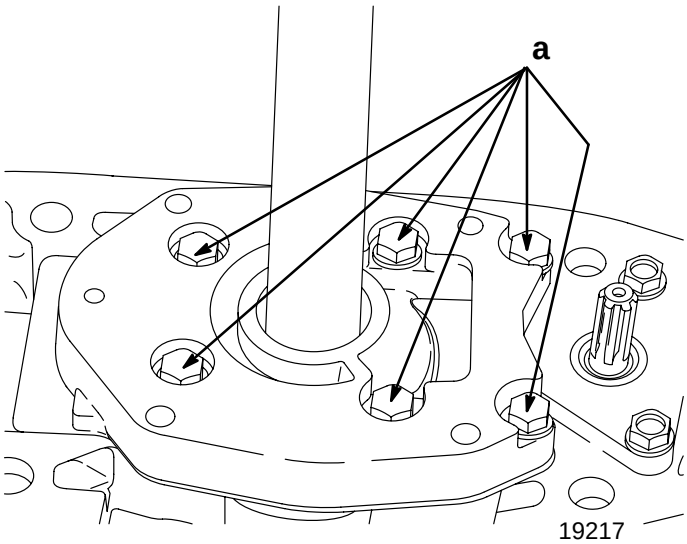
a - Impeller
b - Drive Key
c - Gasket

7. Inspect impeller. Replace impeller if any of the following conditions exist:
   - Impeller blade(s) are cracked, torn, or worn.
   - Impeller is glazed or melted (caused by operation without sufficient water supply).
   - Rubber portion of impeller is not bonded to impeller hub.
8. Remove plate and gasket.
9. Replace plate if groove(s) (other than impeller sealing bead groove) in plate are more than 0.030″ (0.762mm) deep.



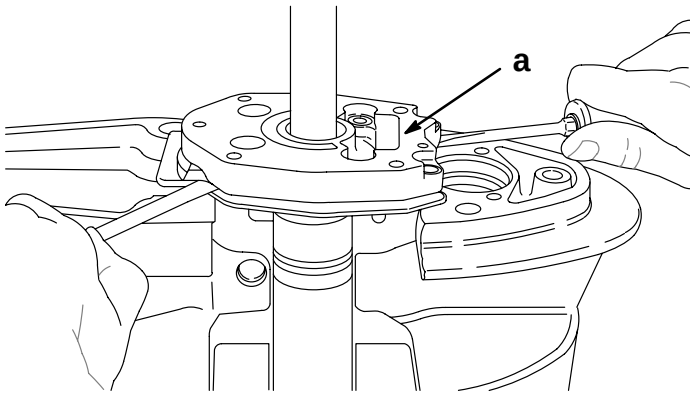
a - Plate
b - Gasket
c - Impeller Sealing Groove

10. Remove bolts and washers.



a - Bolts and Washers (6 each)

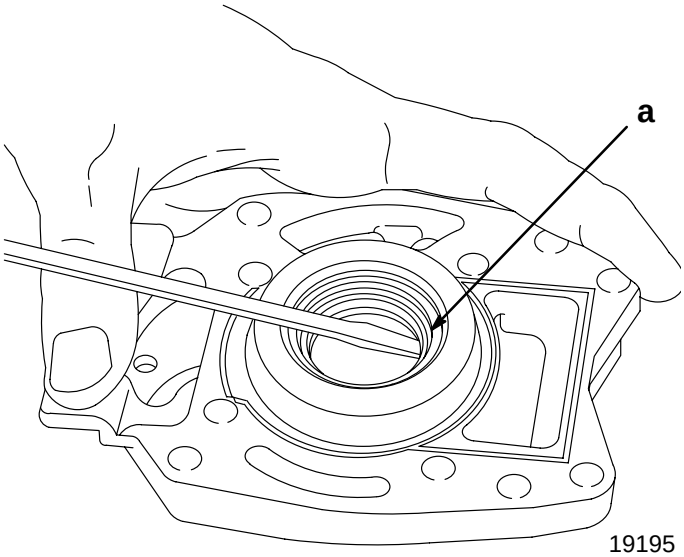
11. Remove water pump base.



19226

a - Water Pump Base

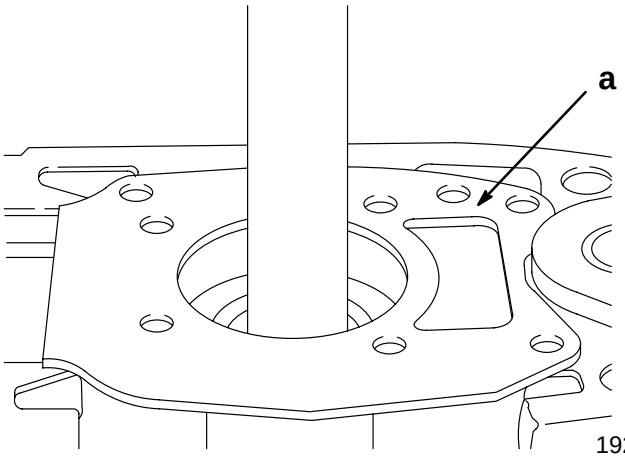
12. Remove (and discard) seals.



19195

a - Seals

13. Remove gasket.

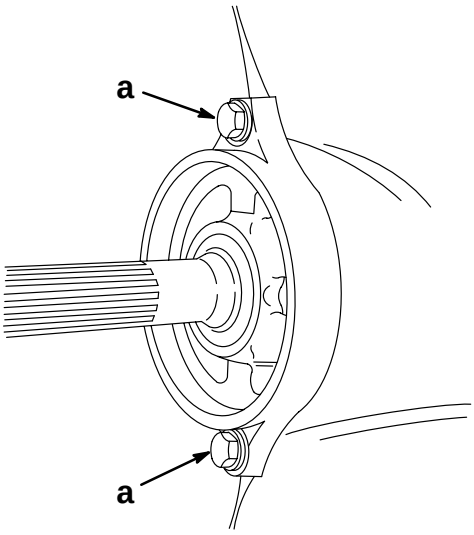


19218

a - Gasket

Bearing Carrier and Propeller Shaft

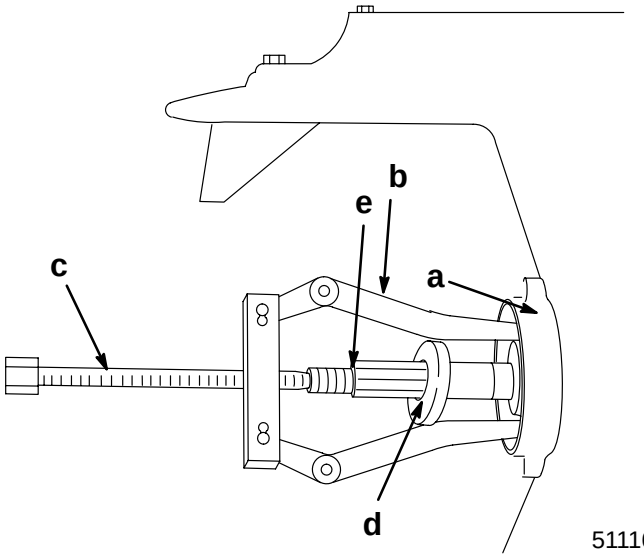
1. Drain lubricant from gear housing; refer to “Draining and Inspecting Gear Housing Lubricant.”
2. Remove bolts and washers or self locking nuts if applicable.



51117

a - Bolt and Washers or Locknuts

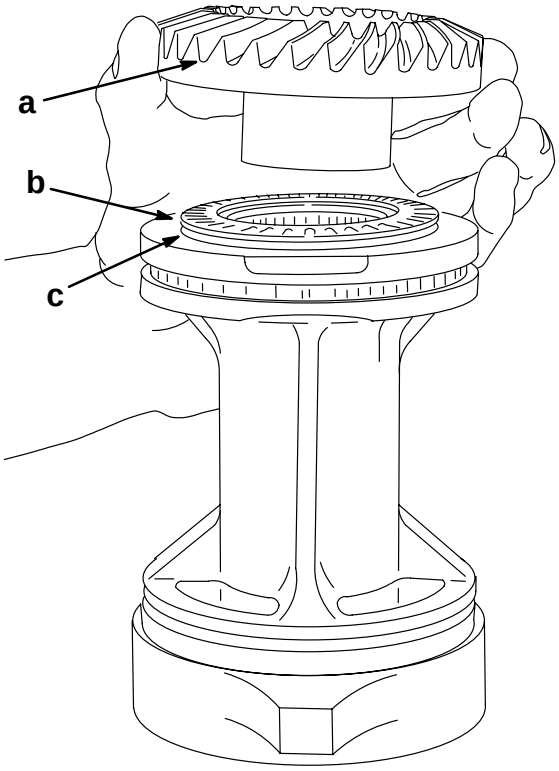
3. With propeller shaft horizontal, pull carrier to break seal with gear housing. Remove bearing carrier/propeller shaft components as an assembly, taking care not to lose cam follower or 3 metal balls in end of propeller shaft.
4. Remove propeller shaft from bearing carrier.



51116

a - Bearing Carrier
b - Puller Jaws (91-46086A1)
c - Puller Bolt (91-85716)
d - Thrust Hub
e - Propeller Shaft

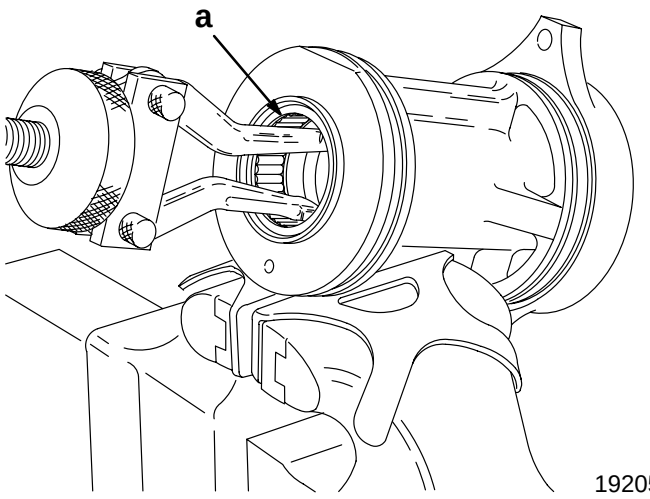
5. Lift reverse gear, thrust bearing and thrust washer from bearing carrier.
6. Replace reverse gear if gear teeth or clutch teeth on reverse gear are chipped or worn. If reverse gear must be replaced, pinion gear and sliding clutch should be inspected for damage.
7. Replace thrust bearing and thrust washer if rusted or damaged.



19202

a - Reverse Gear
b - Thrust Bearing
c - Thrust Washer

8. If bearing is rusted or does not roll freely, replace bearing. Remove bearing using Slide Hammer (91-34569A1).

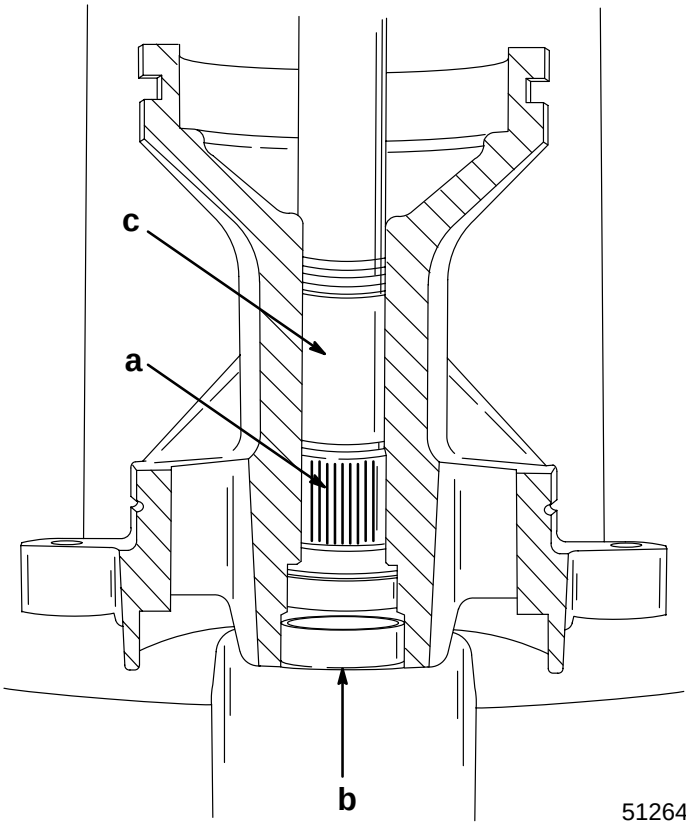


19205

a - Bearing

9. If bearing is rusted or does not roll freely, replace bearing. Remove bearing and oil seals using Mandrel* (91-36569) and Driver Rod* (91-37323). Discard oil seals.

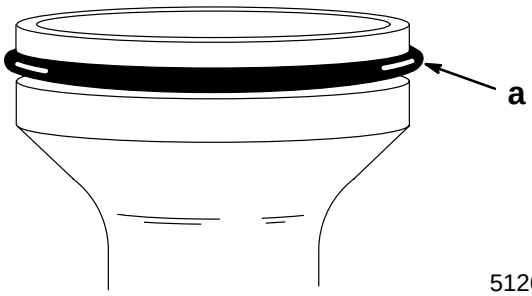
* From Bearing Removal and Installation Kit (91-31229A5).



51264

a - Bearing
b - Mandrel (91-26569)
c - Driver Rod (91-37323)

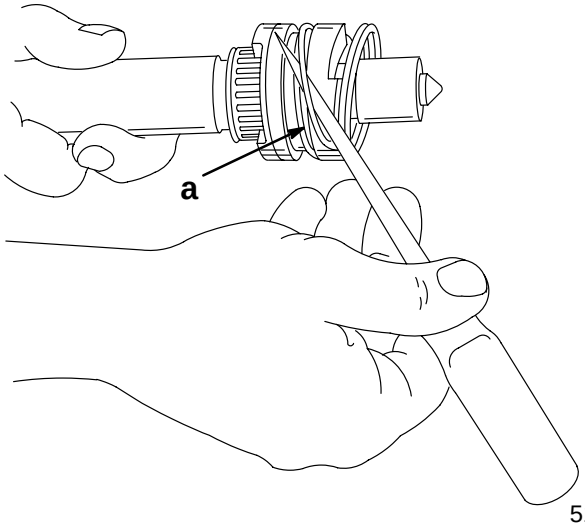
10. Remove (if not removed with bearing in Step 9) propeller shaft seals and bearing carrier O-ring.



51263

a - O-ring

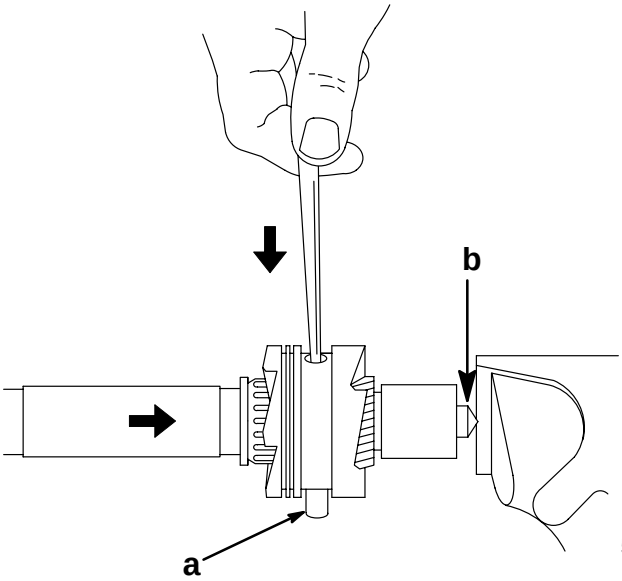
11. Remove spring.



51876

a - Spring

12. Apply constant pressure to cam follower to prevent cam follower assembly from ejecting from propeller shaft while pushing cross pin out of clutch dog.



51800

a - Cross Pin
b - Cam Follower

13. Remove components from propeller shaft.

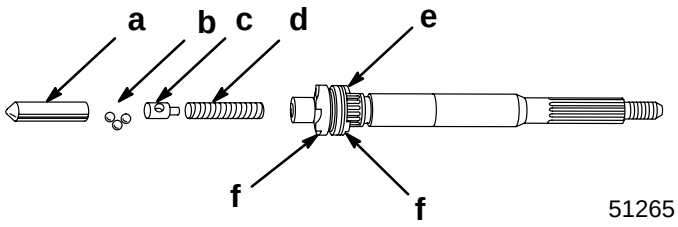
14. Replace cam follower if worn or pitted.

15. Replace sliding clutch if jaws are rounded or chipped. Rounded jaws indicate one or more of the following:

    a. Improper shift cable adjustment.

    b. Engine idle speed too high while shifting.

    c. Shifting from neutral to reverse (or forward) too slowly.



51265

a - Cam Follower
b - 3 Metal Balls
c - Guide Block
d - Spring
e - Sliding Clutch
f - Jaws

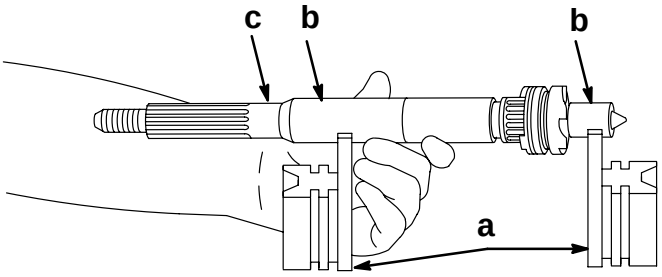
16. Check bearing surfaces of propeller shaft for pitting or wear. If shaft is worn or pitted, replace shaft and corresponding bearing.

17. Replace propeller shaft if any of the following exist:

    a. Splines are twisted or worn.

    b. Oil seal surface is grooved.

    c. Shaft has a noticeable “wobble” or is bent more than 0.009 in. (0.228mm). Prop shaft trueness should be measured with a dial indicator with prop shaft on V-blocks.

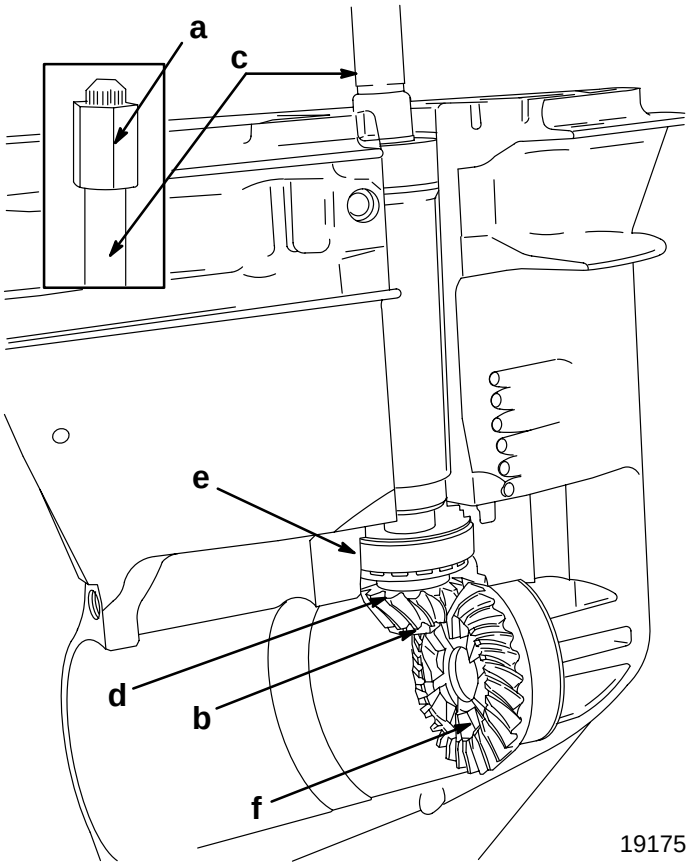


51877

a - V-Blocks
b - Bearing Surfaces
c - Measure with Dial Indicator at This Point.

Pinion Gear, Drive Shaft, and Forward Gear

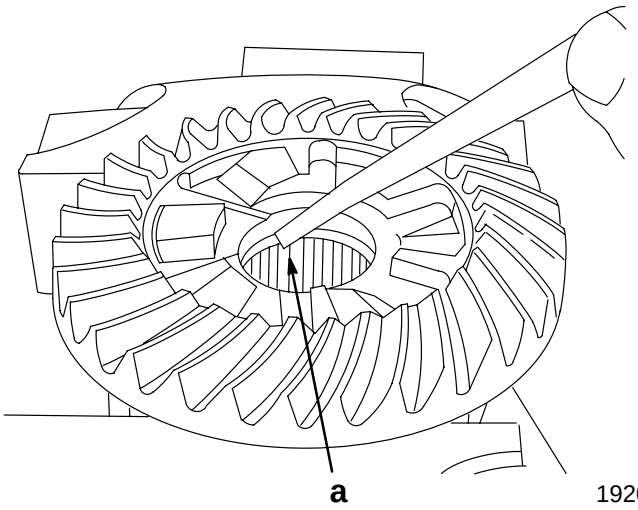
1. Hold drive shaft using Drive Shaft Holding Tool (91-56775); remove (and discard) pinion nut.
2. Remove drive shaft, pinion gear, bearing and forward gear .
3. Replace pinion gear if it is chipped or worn.
4. Replace bearing and race if either are rusted or damaged; or if bearing does not roll freely. To remove race, refer to “Lower Drive Shaft Bearing Race,” following.
5. Replace forward gear if gear teeth or clutch teeth are chipped or worn.



19175

a - Drive Shaft Holding Tool (91-817070)
b - Pinion Nut
c - Drive Shaft
d - Pinion Gear
e - Bearing
f - Forward Gear

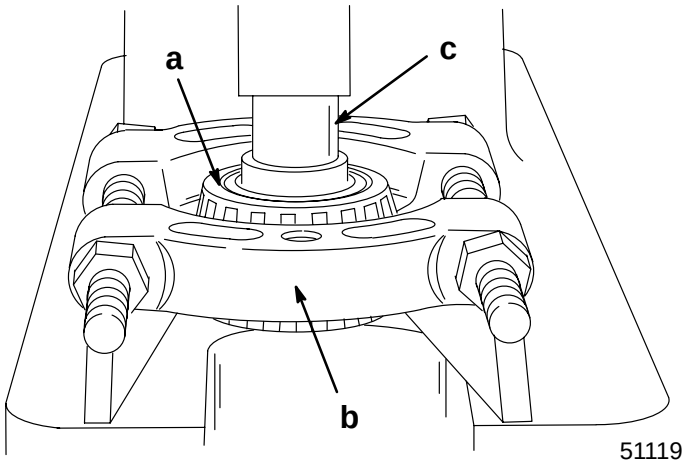
6. Replace bearing if it is rusted or does not roll freely; use a punch and hammer to remove bearing.



19203

a - Bearing

7. Replace forward gear bearing and race if either are rusted or damaged; or if bearing does not roll freely. Remove bearing from gear using Universal Puller Plate (91-37241) and mandrel. To remove race, refer to “Forward Gear Bearing Race,” following.



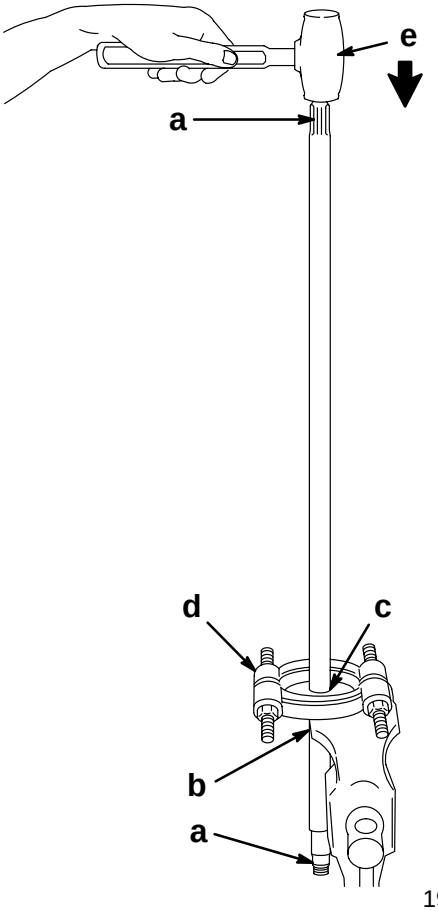
51119

a - Forward Gear Bearing
b - Universal Puller Plate (91-37241)
c - Mandrel

8. Replace drive shaft if splines are worn or twisted.
9. If bearing surface is damaged, replace drive shaft and corresponding bearing.

IMPORTANT: Do not tighten vise against drive shaft.

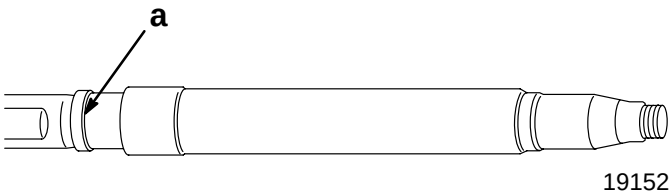
10. If wear sleeve is deeply grooved allowing water to enter gear case, remove (and discard) sleeve using Universal Puller Plate (91-37241) and mallet.



19710

a - Splines
b - Bearing Surface
c - Wear Sleeve
d - Universal Puller Plate (91-37241)
e - Mallet

11. Remove (and discard) rubber ring.

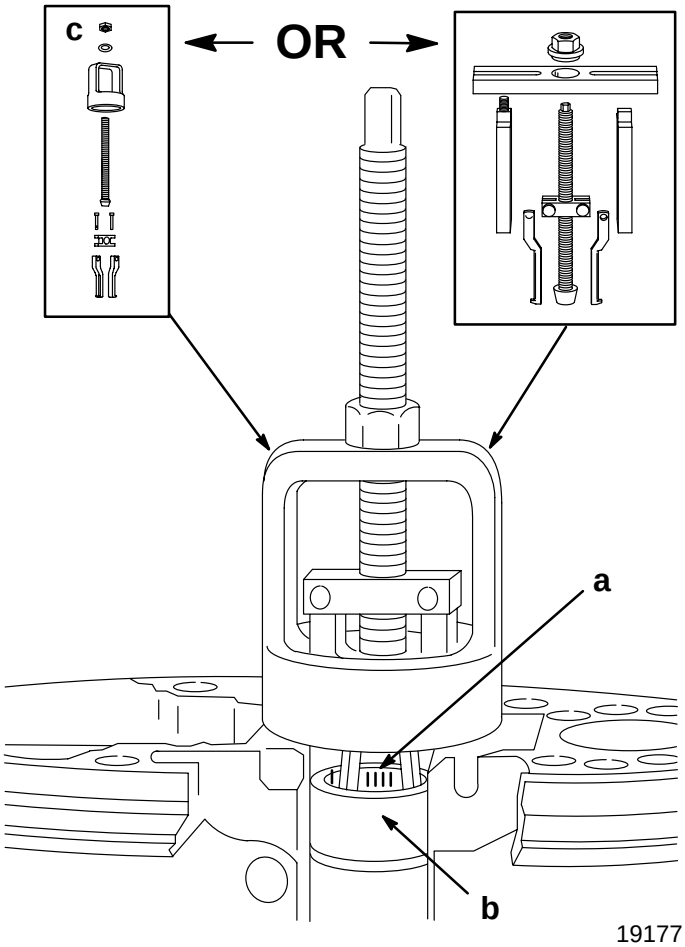


19152

a - Rubber Ring

Upper Drive Shaft Bearing

1. Replace upper drive shaft bearing and sleeve if either are rust stained, or if bearing will not roll freely. Remove bearing and then sleeve using Puller Assembly (91-83165M) with suitable jaws.



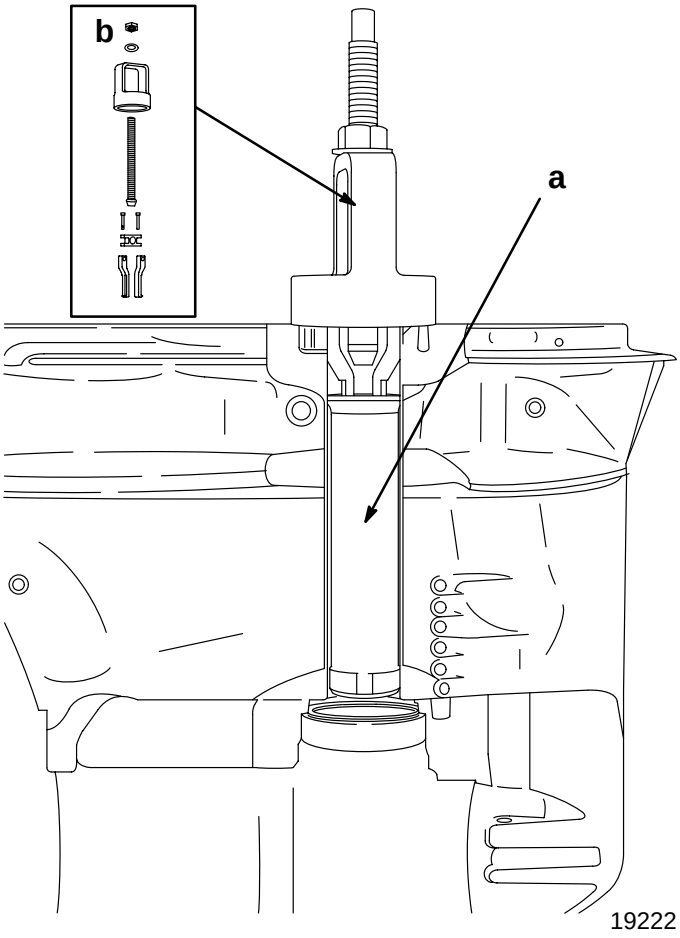
19177

a - Upper Drive Shaft Bearing
b - Sleeve
c - Puller Assembly (91-83165M)

IMPORTANT: Upper drive shaft bearing/sleeve must be removed prior to oil sleeve removal. Refer to “Upper Drive Shaft Bearing,” preceding.

Oil Sleeve

1. Remove oil sleeve (if necessary) using Puller Assembly (91-83165M) with suitable jaws.



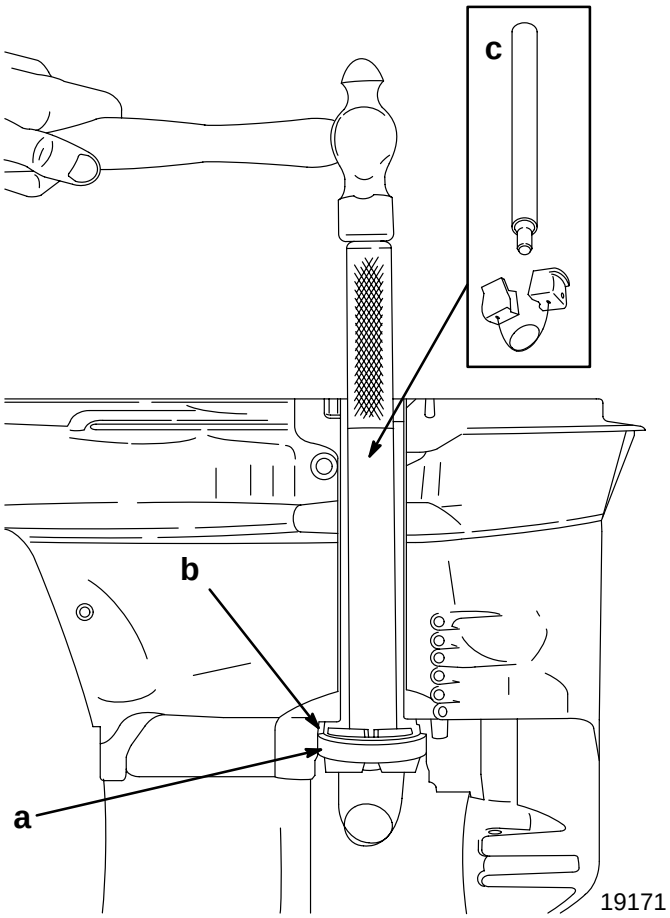
a - Oil Sleeve
b - Puller Assembly (91-83165M)

IMPORTANT: Upper drive shaft bearing/sleeve and oil sleeve do not have to be removed for lower drive shaft bearing race removal.

Lower Drive Shaft Bearing Race

IMPORTANT: Retain shim(s) for reassembly.

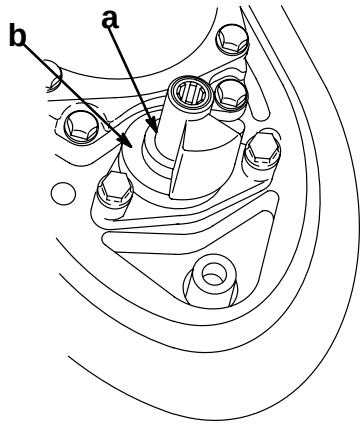
1. Remove race and shim(s) using bearing race tool (91-14308A1).



a - Race
b - Shim(s)
c - Bearing Race Tool (91-14308A1)

Shift Shaft

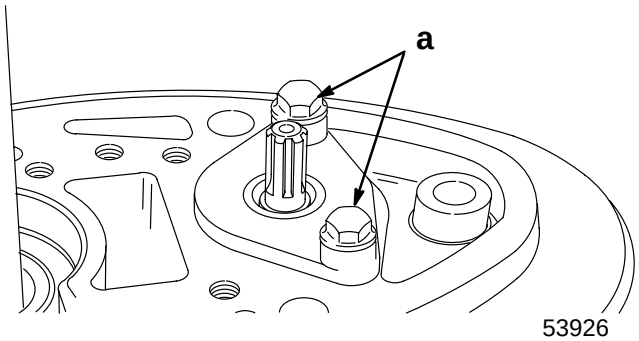
1. Remove shift shaft coupler and nylon spacer.



53925

a - Shift Shaft Coupler
b - Spacer

2. Remove bolts.

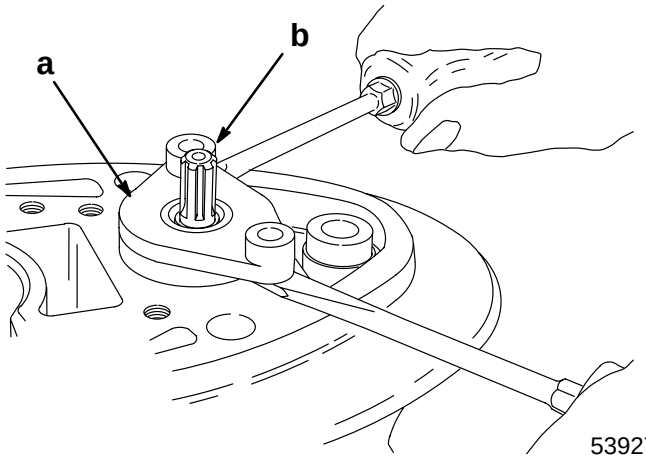


53926

a - Bolts

Note: Gearcase should be in FORWARD for easiest removal of shift shaft.

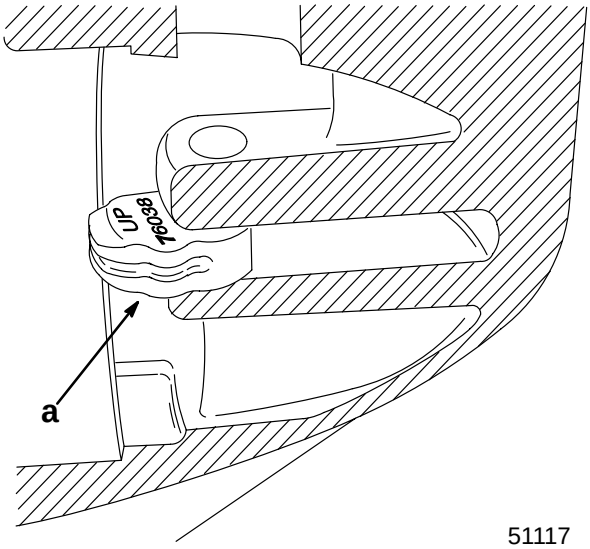
3. Remove shift shaft bushing and shift shaft.



53927

a - Bushing
b - Shift Shaft

4. Remove shift cam from housing.
5. Replace shift cam if worn.

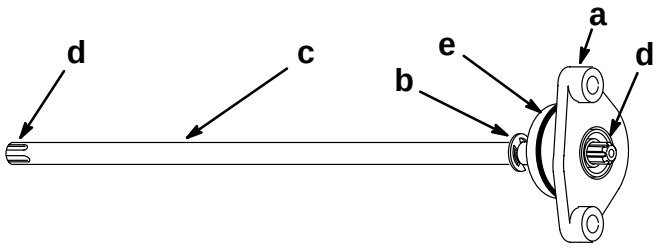


51117

a - Shift Cam

Note: If shift shaft splines are rough, shift shaft seal lips wil be cut during removal/installation.

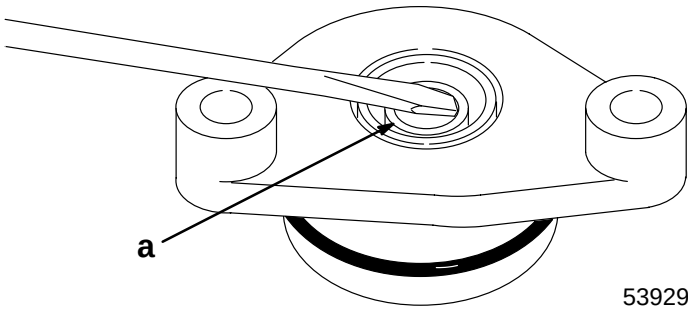
6. Remove shift shaft bushing and clip from shift shaft.
7. Replace shift shaft if splines are worn or shaft is twisted.
8. Remove (and discard) O-ring.



53928

a - Bushing
b - Clip
c - Shift Shaft
d - Splines
e - O-ring

9. Remove (and discard) seal.



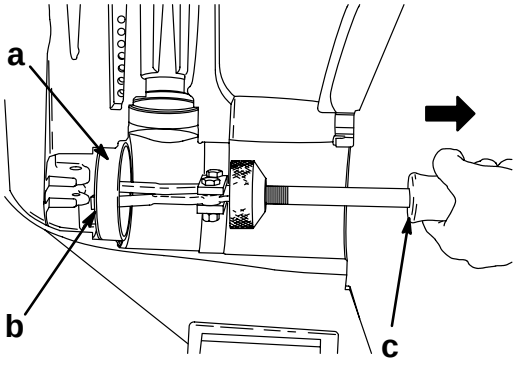
53929

a - Seal

Forward Gear Bearing Race

IMPORTANT: Retain shim(s) for reassembly. If shims are damaged, replace with new shims of equal thickness.

1. Remove race and shim(s) using Slide Hammer (91-34569A1).



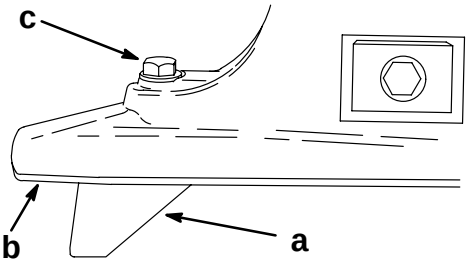
27653

a - Race
b - Shim(s)
c - Slide Hammer (91-34569A1)

Trim Tab Adjustment and Replacement

IMPORTANT: The trim tab is now painted and does NOT aid in protecting the drive shaft housing and gear housing from galvanic corrosion (corrosion and pitting of metal surfaces). Side anodes now provide protection. Do not paint or place protective coating on the side anodes, or corrosion protection function will be lost.

1. Replace trim tab if damaged. Mark location of old trim tab on anti-ventilation plate before removal; install new trim tab in same location.
2. The trim tab provides a means to offset (balance) some of the steering load that is caused by propeller torque at higher operating speeds. If at higher speeds the boat turns more easily to the left, loosen bolt, move the trim tab (trailing edge) to the left (when viewed from behind); retighten bolt. Turn trim tab (trailing edge) to the right if the boat turns more easily to the right.



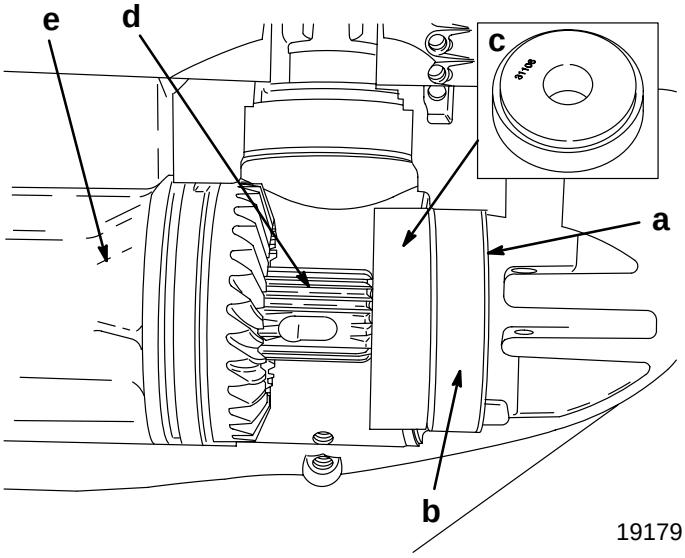
53931

a - Trim Tab
b - Anti-Ventilation Plate
c - Retaining Bolt and Washer; Torque Bolt to 22 lbs. ft. (29.8 N·m)

Reassembly

Forward Gear Bearing Race

1. Place shim(s) (retained from disassembly) into housing. If shim(s) were lost, or a new gear housing is being assembled, start with 0.010″ (0.254mm) shim(s).
2. Assemble components as shown; drive race into housing by striking propeller shaft end with lead hammer.

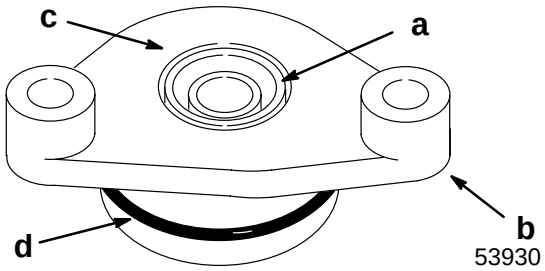


19179

a - Shim(s)
b - Race, Apply 2-4-Cw/Teflon Lubricant on O.D.
c - Mandrel (91-31106)
d - Disassembled Propeller Shaft
e - Assembled Bearing Carrier

Shift Shaft

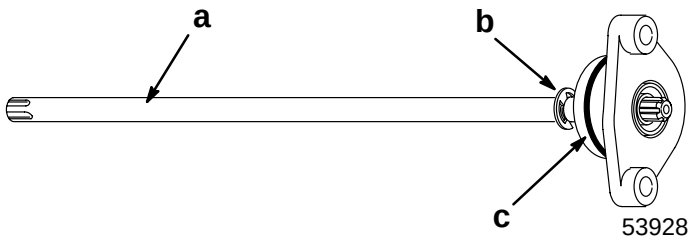
1. Apply Loctite 271 on O.D. of new seal.
2. Press seal into shift shaft bushing until seal is seated against shoulder.
3. Install new O-ring.
4. Apply 2-4-C with Teflon on O-ring and I.D. of seal.



53930

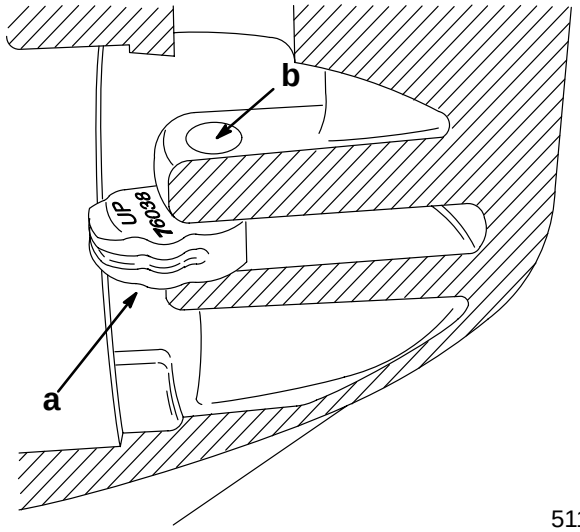
a - Seal
b - Bushing
c - Surface
d - O-ring

5. Assemble components as shown.



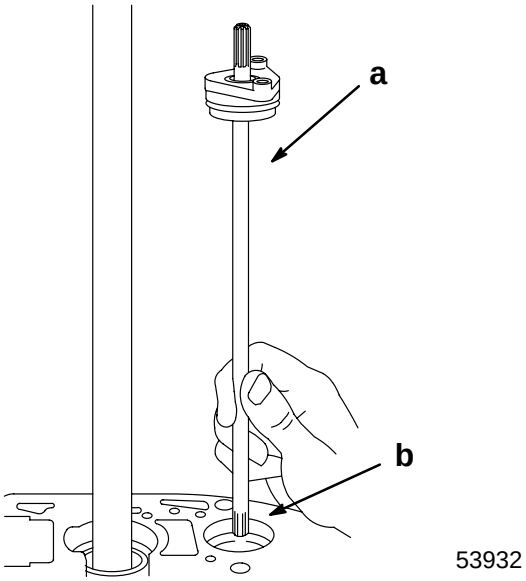
a - Shift Shaft
b - "E" Clip
c - Shift Shaft Bushing

6. Install shift cam (numbers toward top of gear housing); align hole in shift cam with hole.



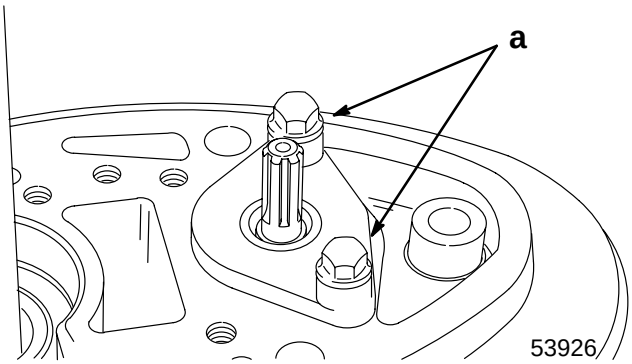
a - Shift Cam (Numbers UP)
b - Hole

7. Install shift shaft assembly; insert splines into shift cam.



a - Shift Shaft Assembly
b - Splines

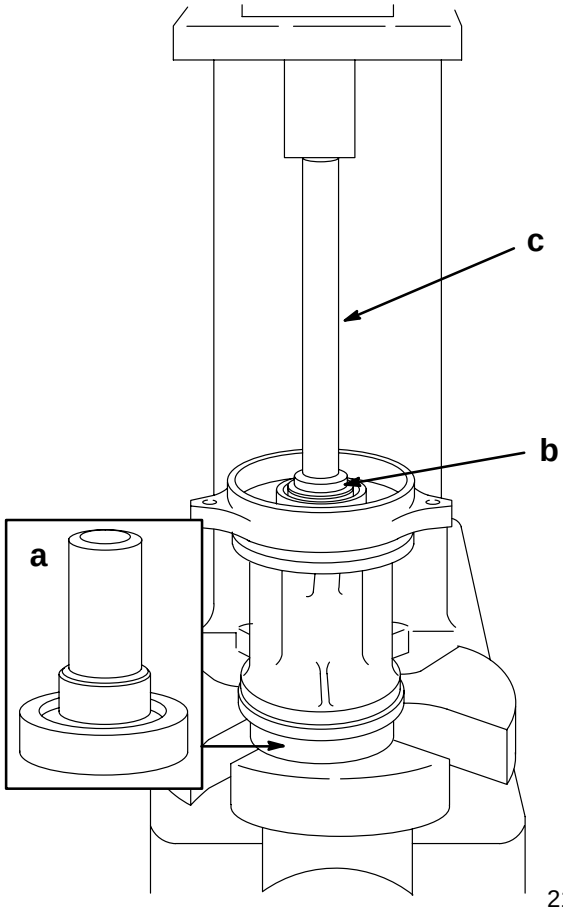
8. Apply Loctite 271 on bottom half of threads of bolts; install bolts and torque to 60 lb. in. (6.5 N·m).



a - Bolts [Torque to 60 lb. in. (6.5 N·m)]

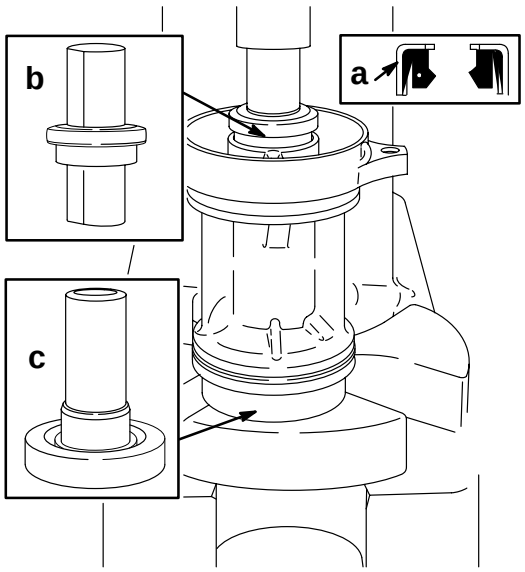
Bearing Carrier Reassembly

1. Lubricate O.D. of bearingand bearing carrier bore with Quicksilver 2-4-C w/Teflon.
2. Protect lip on forward side of bearing carrier, using bearing installation tool (91-13945).
3. Press propeller shaft needle bearing (number side toward mandrel) into carrier, until bearing bottoms out.



a - Bearing Installation Tool (91-13945)
b - Mandrel (91-37263)
c - Suitable Driver Rod

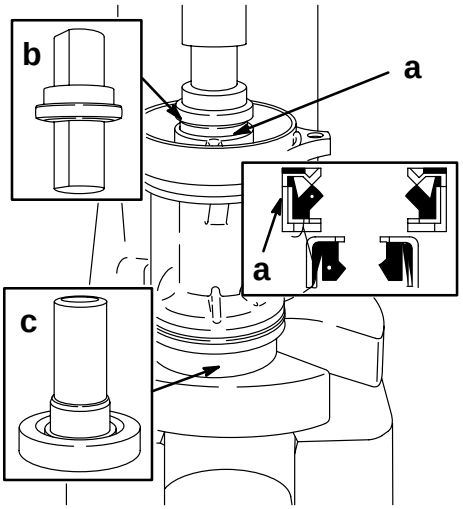
4. Place smaller diameter seal on longer shoulder of Oil Seal Driver (91-31108) with seal lip away from shoulder.
5. Protect lip on front side of bearing carrier using Bearing Installation Tool (91-13945). Apply Loctite 271 on O.D. of seal. Press seal into carrier until tool bottoms.



21040

a - Seal
b - Oil Seal Driver (91-31108)
c - Bearing Installation Tool (91-13945)

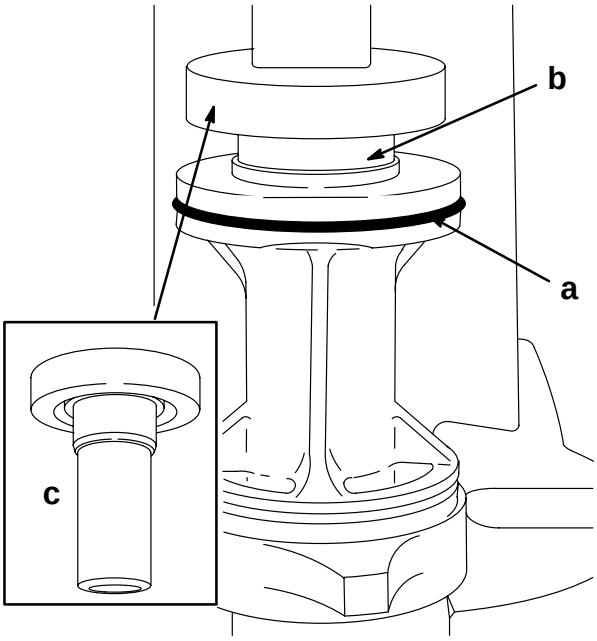
6. Place larger diameter seal on shorter shoulder of Oil Seal Driver (91-31108) with seal lip toward shoulder.
7. Protect lip on front side of bearing carrier using Bearing Installation Tool (91-13945). Apply Loctite 271 on O.D. of new seal. Press seal into carrier until tool bottoms.



21041

a - Seal
b - Oil Seal Driver (91-31108)
c - Bearing Installation Tool (91-13945)

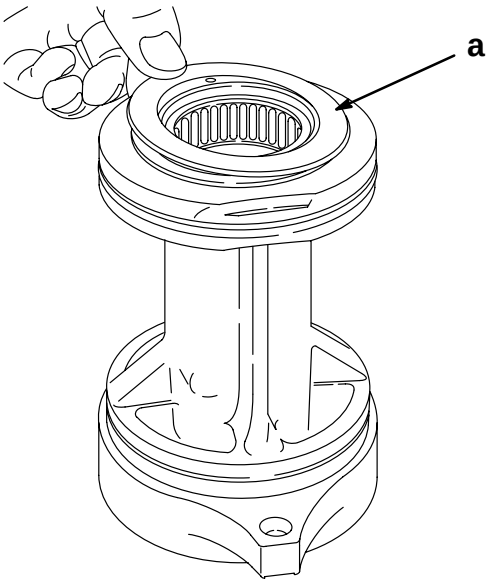
8. Install O-ring.
9. Lubricate O-ring with 2-4-C w/Teflon. Lubricate seal lips with 2-4-C w/Teflon (92-825407A12). Lubricate outside diameter of bearing and bearing carrier bore with a light coating of 2-4-C w/Teflon.
10. Press bearing into carrier until tool bottoms.



19163

a - O-ring
b - Bearing, Numbered Side Toward Tool
c - Bearing Installation Tool (91-13945)

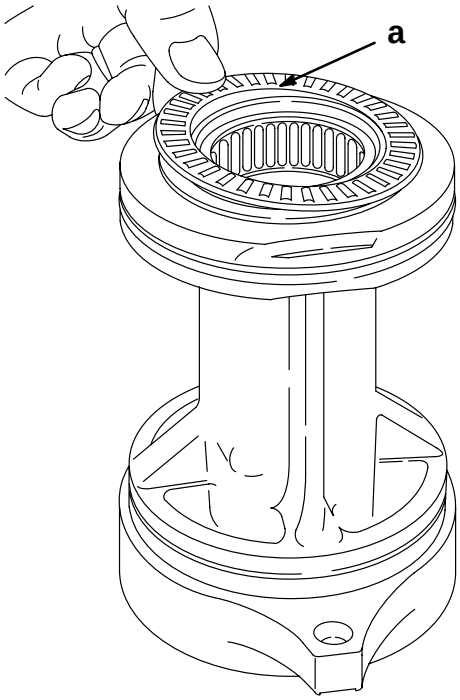
11. Install thrust washer. Coat thrust washer with Quicksilver Gear Lubricant (92-13783A24).



19167

a - Thrust Washer

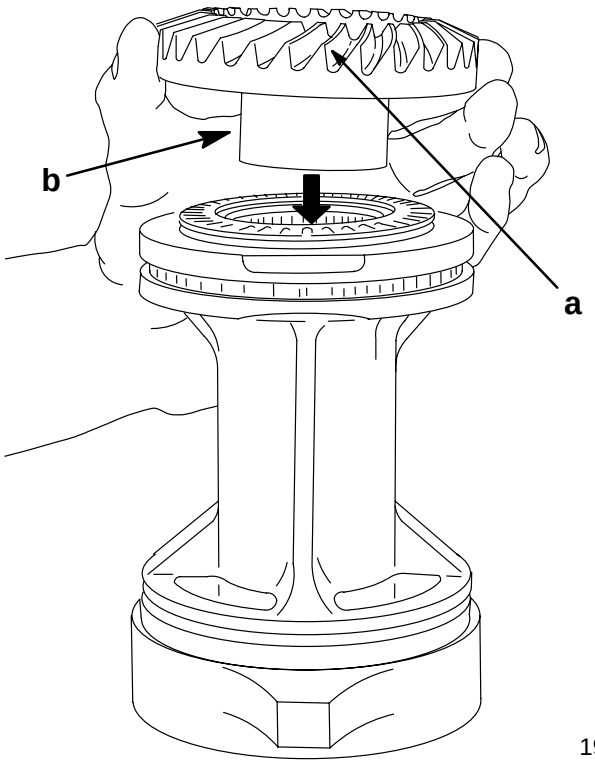
12. Install thrust bearing . Coat thrust bearing with Quicksilver Gear Lubricant (92-13783A24).



19168

a - Thrust Bearing

13. Apply gear lubricant to bearing surface of reverse gear and install reverse gear.

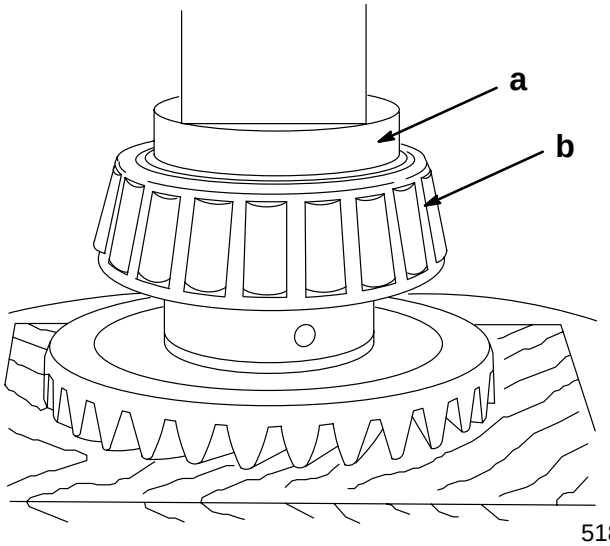


19202

a - Reverse Gear
b - Bearing Surface

Forward Gear Reassembly

1. Press bearing onto gear (press only on inner race of bearing).

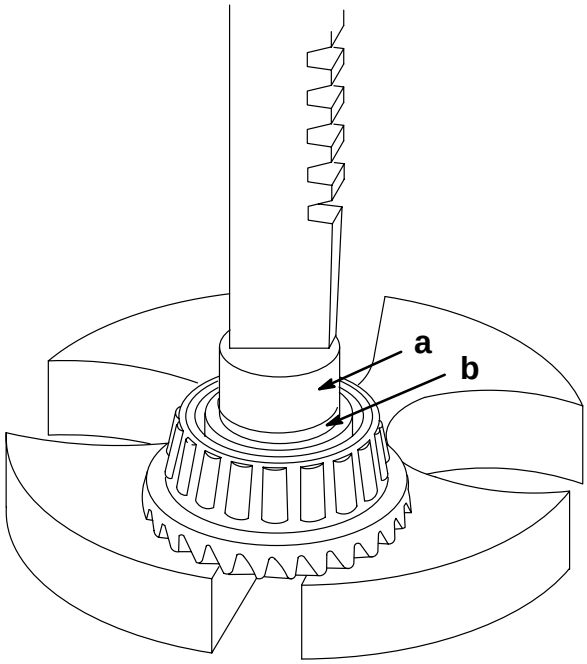


51869

a - Mandrel (91-37350)
b - Bearing; Lubricate I.D. with Quicksilver 2-4-C w/Teflon

2. Apply 2-4-Cw/Teflon to bore in center of gear and to O.D. of bearing.
3. Press bearing into gear until bearing bottoms out.

NOTE: Do not apply pressing force AFTER bearing bottoms out as bearing damage could result.

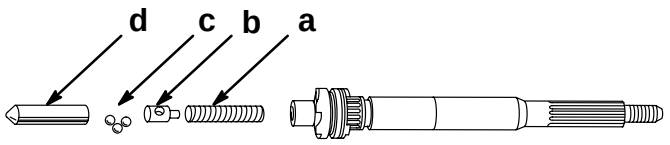


28062

a - Mandrel
b - Bearing, Numbered Side Toward Mandrel

Propeller Shaft Reassembly

1. Install components into propeller shaft in sequence shown.

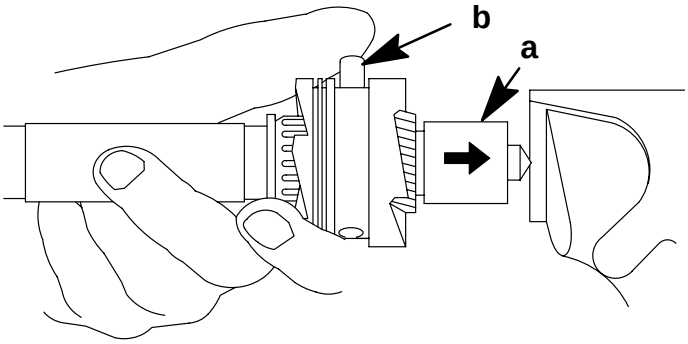


19154

a - Spring
b - Guide Block
c - 3 Metal Balls*
d - Cam Follower*

*Hold in Place With Quicksilver 2-4-C w/Teflon

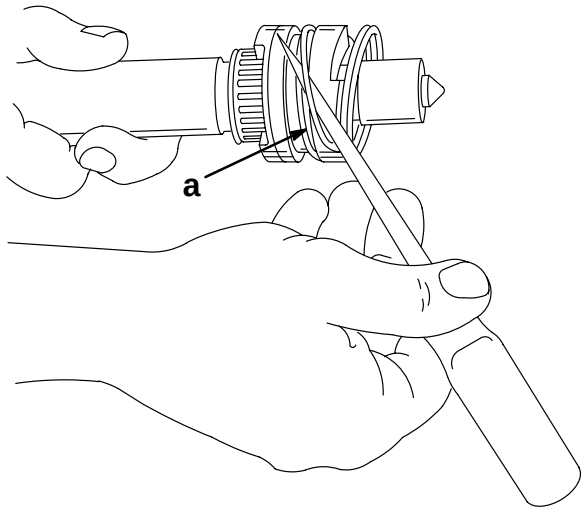
2. Install cross pin.



51800

a - Apply Pressure in This Direction
b - Cross Pin

3. Install spring. DO NOT overlap springs.

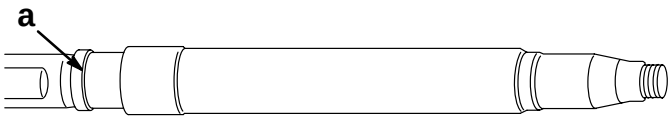


51876

a - Spring

Drive Shaft Wear Sleeve Installation

1. Install new rubber ring.
2. Apply a light coat of Loctite 271 on outside diameter of rubber ring.

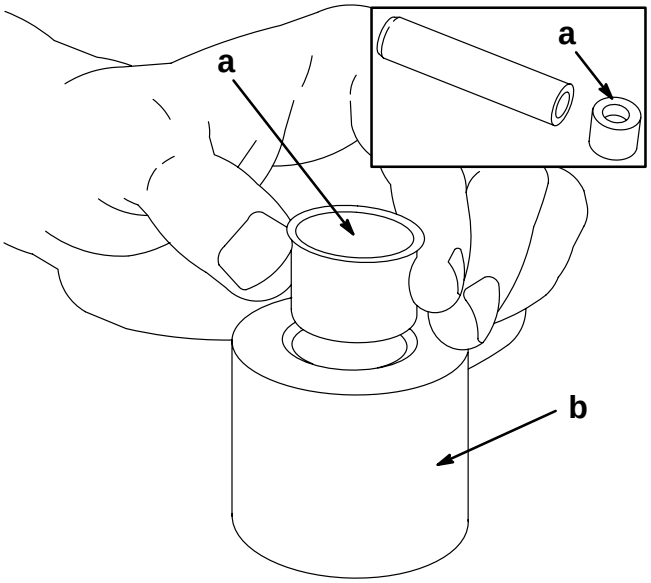


19152

a - Ring

3. Insert sleeve into holder*.

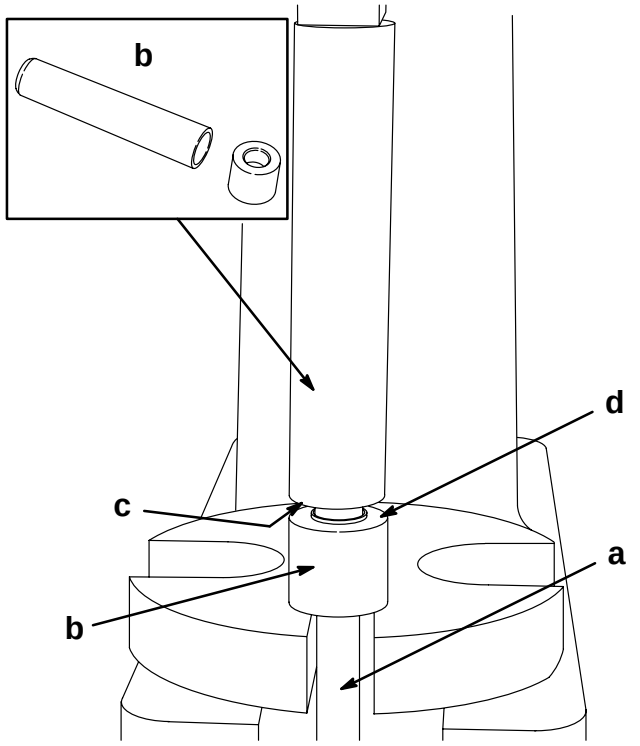
*Component of Wear Sleeve Installation Tool (91-14310A1).



19169

a - Sleeve
b - Holder

4. Press sleeve onto drive shaft using Wear Sleeve Installation Tool (91-14310A1); continue pressing until surface contacts surface.



19166

a - Drive Shaft
b - Wear Sleeve Installation Tool
c - Surface
d - Surface

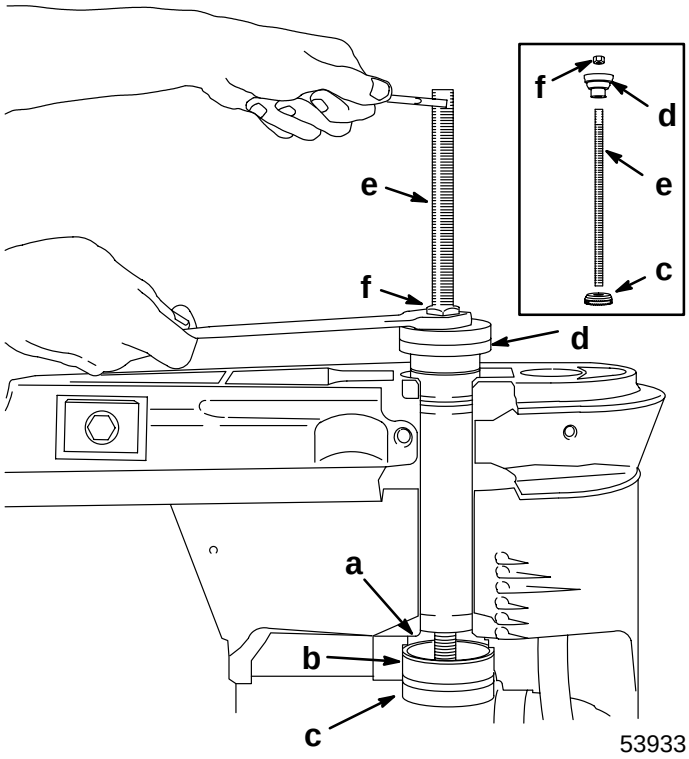
5. Remove excess Loctite from assembled shaft.

Lower Drive Shaft Bearing Race Installation

IMPORTANT: Lower drive shaft bearing cup can be installed with or without upper drive shaft bearing/sleeve and oil sleeve installed.

1. Lubricate O.D. of bearing race with Quicksilver 2-4-C w/Teflon.
2. Install shim(s) and bearing race into housing.

NOTE: Verify shim(s) are not cocked when drawing up race.



53933

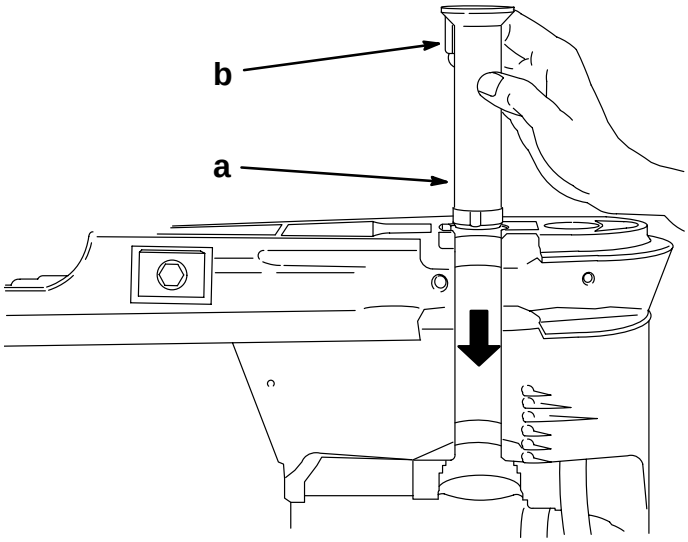
a - Shim(s); Retained From Disassembly. If Shim(s) Were Lost or a New Gear Housing is Being Assembled, Start With 0.025″ (0.635mm) Shim(s)
b - Bearing Race
c - Mandrel*
d - Mandrel*
e - Threaded Rod** (91-31229)
f - Nut** (11-24156)

*From Bearing Installation Tool (91-14309A1)

**From Bearing Removal and Installation Kit (91-31229A5)

Oil Sleeve Installation

1. Install oil sleeve with tab positioned as shown.

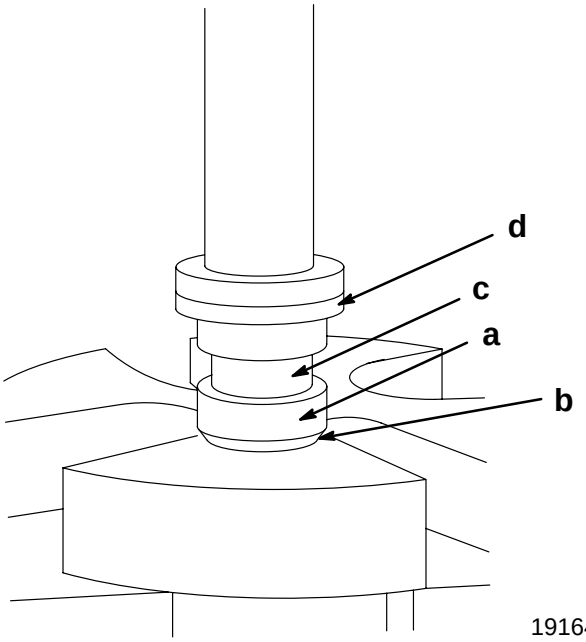


53934

a - Oil Sleeve
b - Tab

Upper Drive Shaft Bearing Installation

1. Lubricate I.D. of bearing holder and O.D. of bearing with 2-4-C w/ Teflon.
2. Press bearing into sleeve.



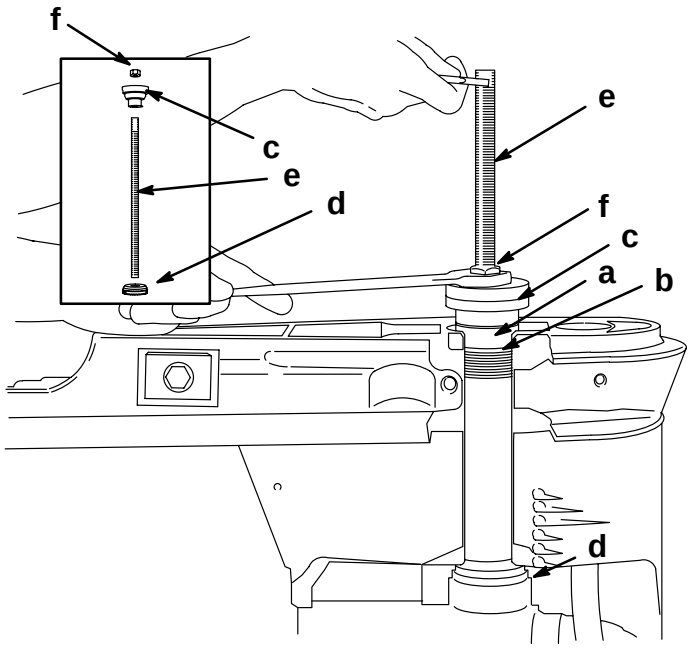
19164

a - Bearing Sleeve
b - Tapered End
c - Bearing; Numbered Side Toward Mandrel
d - Mandrel; From Bearing Installation Tool (91-14309A1)

IMPORTANT: Oil sleeve must be installed prior to upper drive bearing installation.

IMPORTANT: Upper drive shaft bearing/sleeve can be installed with or without lower drive shaft bearing cup installed.

3. Install bearing/sleeve into housing.



53935

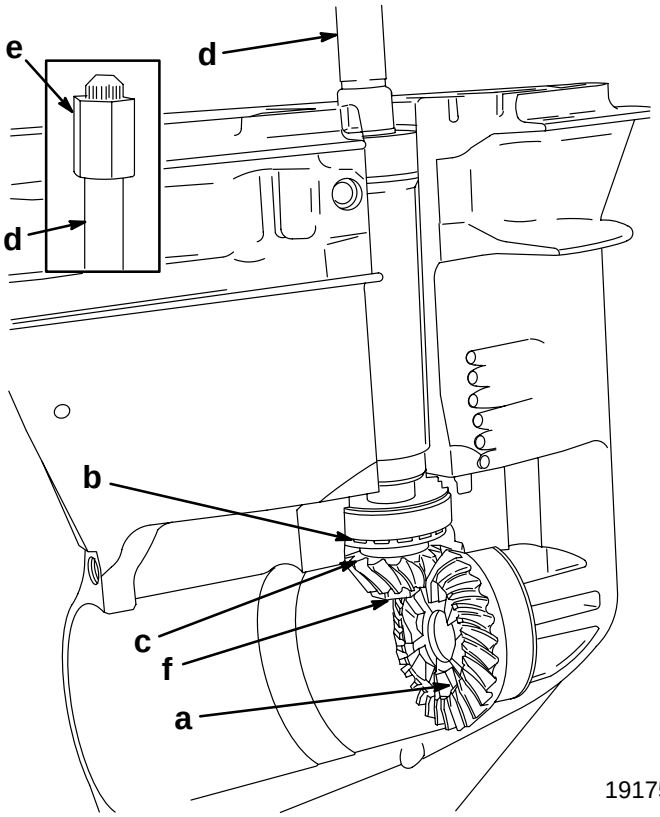
a - Bearing/Sleeve
b - Tapered End
c - Mandrel*
d - Mandrel*
e - Threaded Rod** (91-31229)
f - Nut** (11-24156)

*From Bearing Installation Tool (91-14309A1)

**From Bearing Removal and Installation Kit (91-31229A5)

Forward Gear, Lower Drive Shaft Bearing, Pinion Gear, and Drive Shaft Installation

1. Install components in sequence shown.



19175

a - Forward Gear/Bearing: Work Quicksilver gear lube into bearing rollers.
b - Lower Drive Shaft Tapered Roller Bearing: Work Quicksilver gear lube into bearing rollers.
c - Pinion Gear
d - Drive Shaft
e - Drive Shaft Holding Tool (91-817070)
f - Pinion Nut (New): Apply Loctite 271 to threads during final assembly (after pinion gear depth and forward gear backlash have been set), torque to 70 lb. ft. (95 N·m).

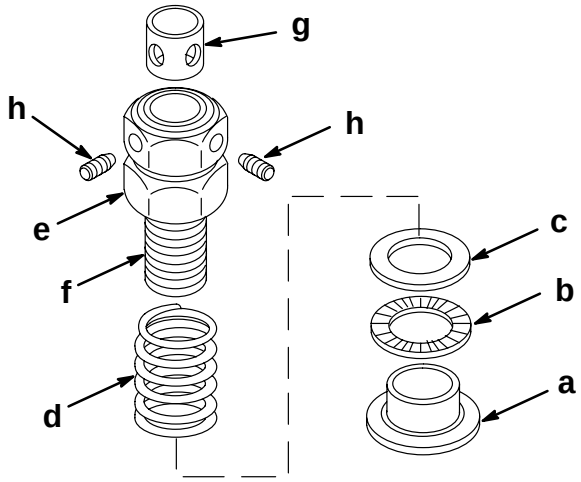
Pinion Gear Depth and Forward Gear Backlash

DETERMINING PINION GEAR DEPTH

NOTE: *Read entire procedure before attempting any change in shim thickness.*

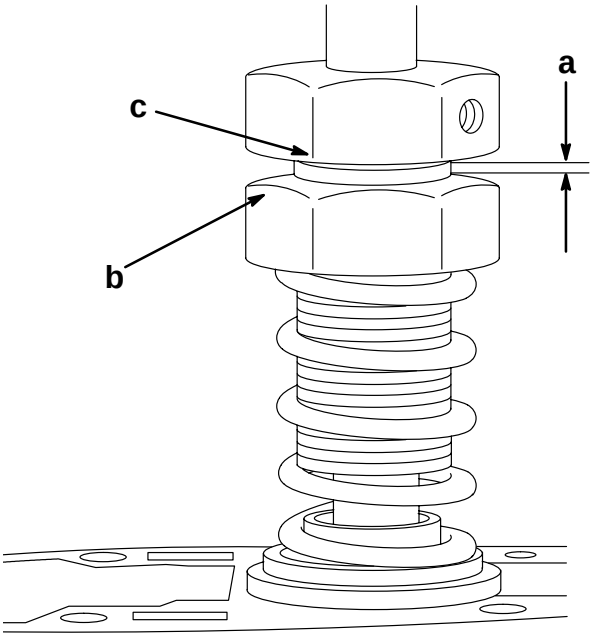
IMPORTANT: Forward gear assembly must be installed in gear housing when checking pinion gear depth or an inaccurate measurement will be obtained.

1. Clean the gear housing bearing carrier shoulder and diameter.
2. With gear housing positioned up right (drive shaft vertical), install Bearing Preload Tool (91-14311A1) over drive shaft in sequence shown.



a - Adaptor: Bearing surfaces clean and free of nicks
b - Thrust Bearing: Oiled and able to move freely
c - Thrust Washer: Clean and free of nicks and bends
d - Spring
e - Nut: Threaded all-the-way onto bolt
f - Bolt: Held snug against spring
g - Sleeve: Holes in sleeve must align with set screws
h - Set Screw (2): Tightened against drive shaft, bolt should not slide on drive shaft.

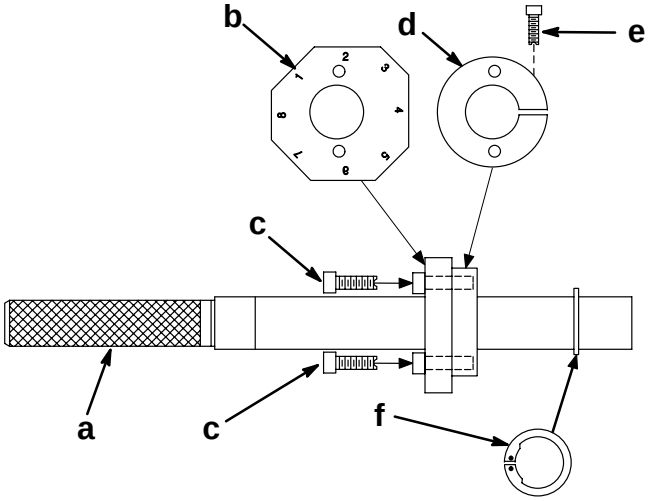
3. Measure distance between top of nut and bottom of bolt head.
4. Increase distance by 1″ (25.4mm).
5. Rotate drive shaft 5 to 10 revolutions. This should properly seat upper drive shaft tapered roller bearing.



19884

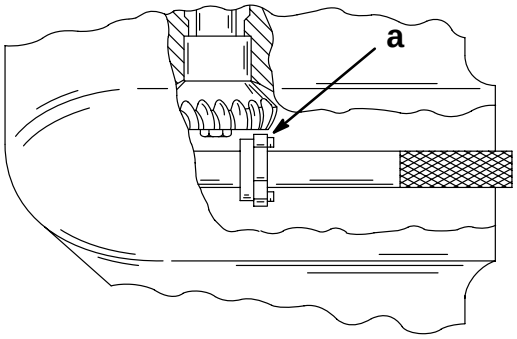
a - 1“ (25.4mm)
b - Nut
c - Bolt Head

6. Assemble Pinion Gear Locating Tool (91-12349A2) as shown; do not tighten collar retaining bolt at this time.



a - Arbor
b - Gauging Block; Install With Numbers Away From Split Collar
c - Bolt; Gauging Block Retaining
d - Split Collar
e - Bolt; Collar Retaining
f - Snap Ring

7. Insert tool into forward gear assembly; position gauging block under pinion gear as shown.



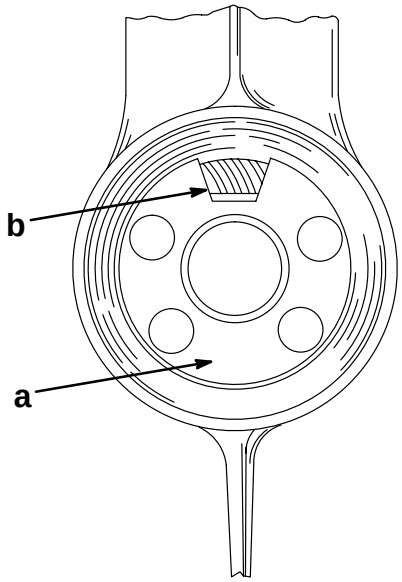
22067

a - Gauging Block

8. Remove tool, taking care not to change gauging block position, and tighten collar retaining bolt.
9. Insert tool into forward gear assembly; position proper numbered flat (from chart) of gauging block – under pinion gear.

MODEL	GEAR RATIO (PINION GEAR TEETH/ REVERSE GEAR TEETH)	USE FLAT NO.
60 Big Foot, 60 SeaPro/Marathon	13/30	8
75-thru-90 (3 Cylinder)	13/30	8
100/115/125 (4 Cylinder)	14/29	2

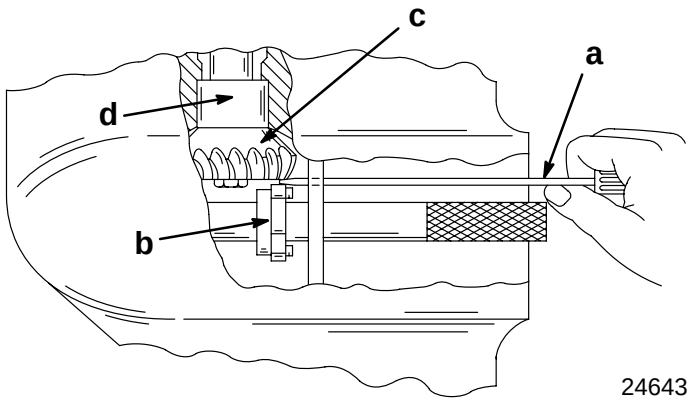
10. Install the number "3" locating disc against bearing carrier shoulder in gear housing.
11. Position access hole as shown.



24643

a - Locating Disc
b - Access Hole

12. Determine pinion gear depth by inserting a feeler gauge thru access hole in locating disc.
13. The correct clearance between gauging block and pinion gear is 0.025″ (0.64mm).
14. If clearance is correct, leave Bearing Preload Tool on drive shaft and proceed to "Determining Forward Gear Backlash," following.
15. If clearance is incorrect, add (or subtract) shims from above bearing race to lower (or raise) pinion gear. When reinstalling pinion nut, apply Loctite 271 on threads of nut.



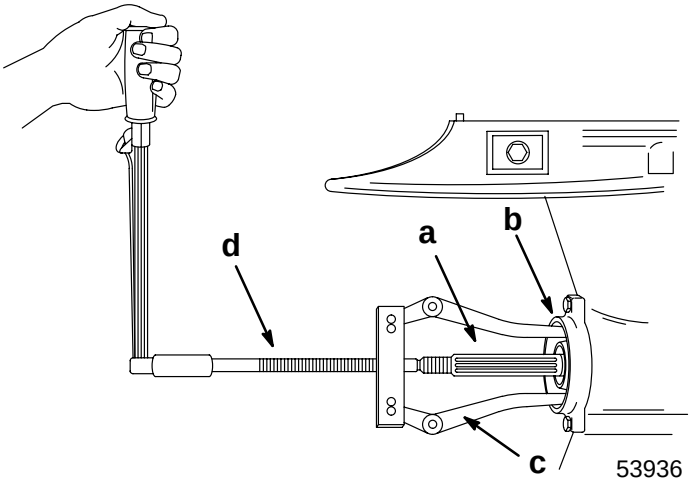
24643

a - Feeler Gauge
b - Gauging Block
c - Pinion Gear
d - Bearing Race

DETERMINING FORWARD GEAR BACKLASH

NOTE: *Read entire procedure before attempting any change in shim thickness.*

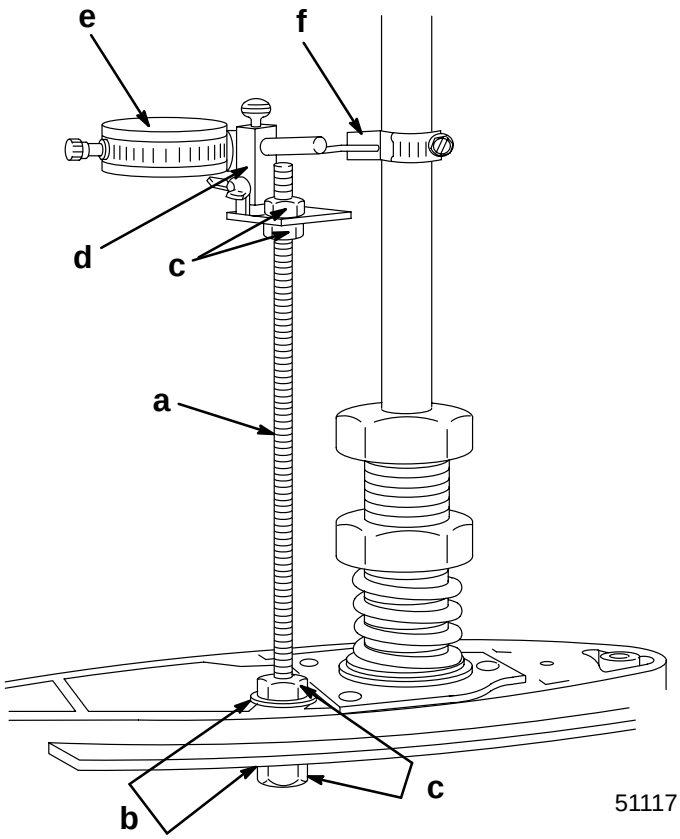
1. Obtain correct pinion gear depth; refer to “Determining Pinion Gear Depth,” preceding.
2. Install Bearing Preload Tool (91-14311A1) on drive shaft; refer to “Determining Pinion Gear Depth,” preceding.
3. Install components as shown.



a - Propeller Shaft*
b - Bearing Carrier* (Assembled)
c - Puller Jaws (91-46086A1)
d - Puller Bolt (91-85716); Torque to 45 lbs. in. (5.0 N·m)

*Refer to “Bearing Carrier and Propeller Shaft Installation,” following.

4. Rotate drive shaft 5 to 10 revolutions. This should properly seat forward gear tapered roller bearing.
5. Install components as shown.



a - Threaded Rod (Obtain Locally)
b - Washers
c - Nuts
d - Dial Indicator Adaptor Kit (91-83155)
e - Dial Indicator (91-58222A1)
f - Backlash Indicator Tool

6. Position Dial Indicator on appropriate line (from chart) marked on Backlash Indicator Tool.

MODEL	ALIGN POINTER OF DIAL INDICATOR WITH MARK
60 Big Foot, 60 SeaPro/Marathon Backlash Indicator Tool (91-78473)	4
75-thru-90 (3 Cylinder) Backlash Indicator Tool (91-78473)	4
100/115/125 (4 Cylinder) Backlash Indicator Tool (91-19660)	1

7. Lightly turn drive shaft back-and-forth (no movement should be noticed at propeller shaft).
8. Dial Indicator registers amount of backlash, which must be between specification shown in chart.

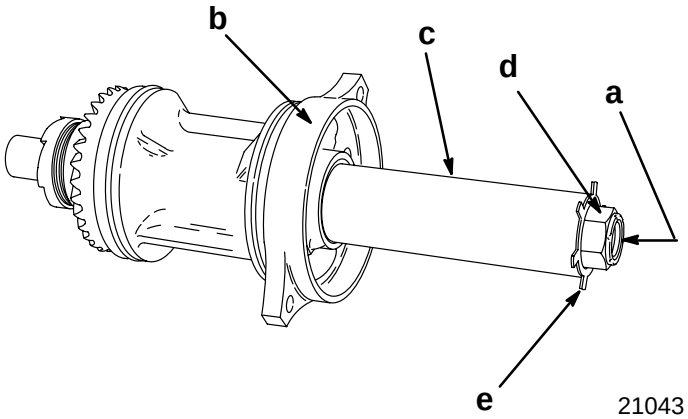
MODEL	DIAL INDICATOR MINIMUM	READING MAXIMUM
60 Big Foot, 60 SeaPro/Marathon	0.012 in. (0.30mm)	0.019 in. (.48mm)
75-thru-90 (3 Cylinder)	0.012 in. (0.30mm)	0.019 in. (.48mm)
100/115/125 (4 Cylinder)	0.015 in. (0.38mm)	0.022 in. (0.55mm)

9. If backlash is less than the minimum specification, remove shim(s)* from in front of forward gear bearing race to obtain correct backlash. When reinstalling pinion nut, apply Loctite 271 on threads of nut.
10. If backlash is more than the maximum specification, add shim(s)* in front of forward gear bearing race to obtain correct backlash. When reinstalling pinion nut, apply Loctite 271 on threads of nut.

* By adding or subtracting 0.001″ (0.025mm) shim, the backlash will change approximately 0.001″ (.025mm).

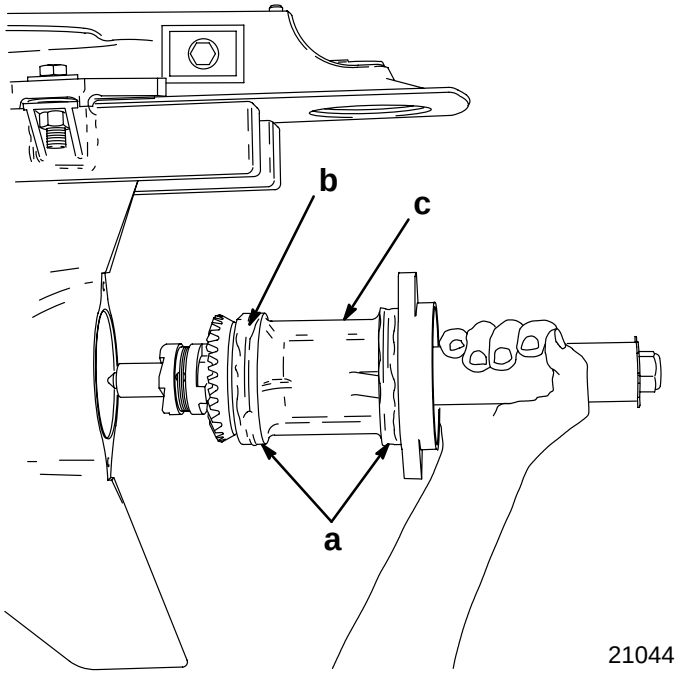
Bearing Carrier and Propeller Shaft Installation

1. Insert propeller shaft assembly into bearing carrier.
2. Before installing bearing carrier assembly into gear housing, obtain locally a 6″ (152.4mm) long by 1-1/4″ – 1-1/2″ (31.7 – 38.1mm) diameter piece of PVC pipe (c). Install the PVC pipe over the prop shaft (a) and secure the pipe against the bearing carrier assembly (b) with the propeller nut (d) and tab washer (e). This will allow the reverse gear to apply pressure to the reverse gear thrust bearing to prevent the thrust bearing from being inadvertently dislodged as the bearing carrier assembly is installed in the gear housing.



21043

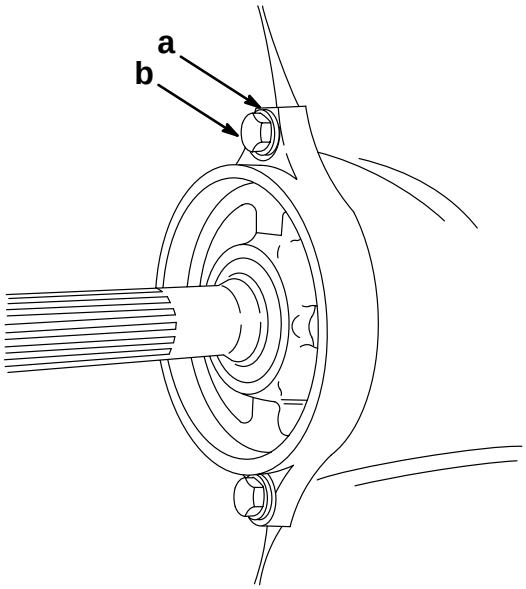
3. Lubricate o-ring and mating surfaces with 2-4-C w/Teflon (92-825407A12).
4. Install bearing carrier and propeller shaft into housing with the word “TOP” located on flange toward top of housing.



21044

a - Apply 2-4-C w/Teflon
b - O-ring
c - TOP

5. Install components as shown.



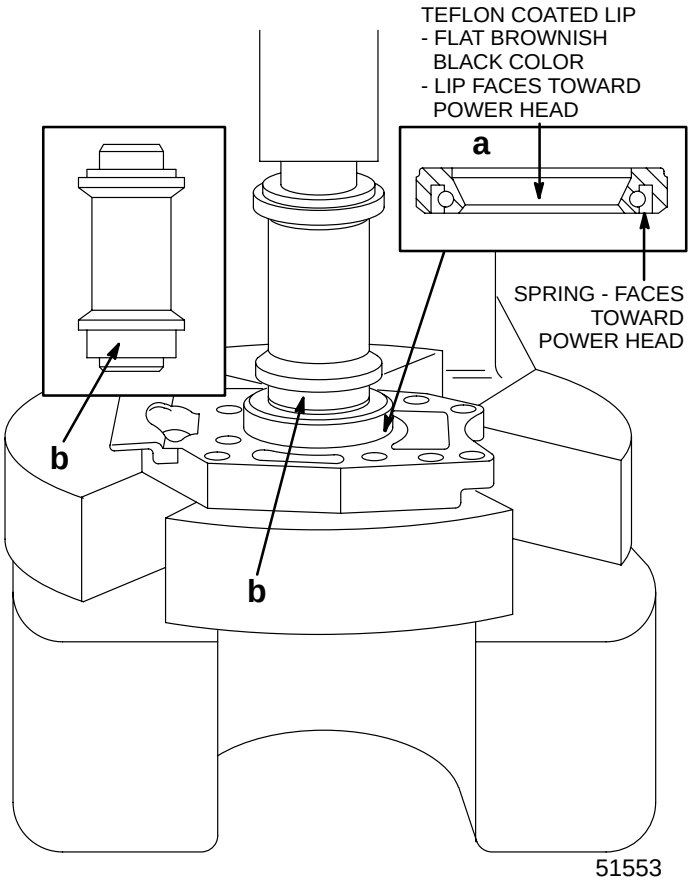
19147

a - Washers
b - Bolts; Apply Loctite 271 on Threads and Torque to 25 lb. ft. (34.0 N·m)

NOTE: *If nuts are used in place of bolts, torque nuts to 25 lb. ft. (34.0 N·m).*

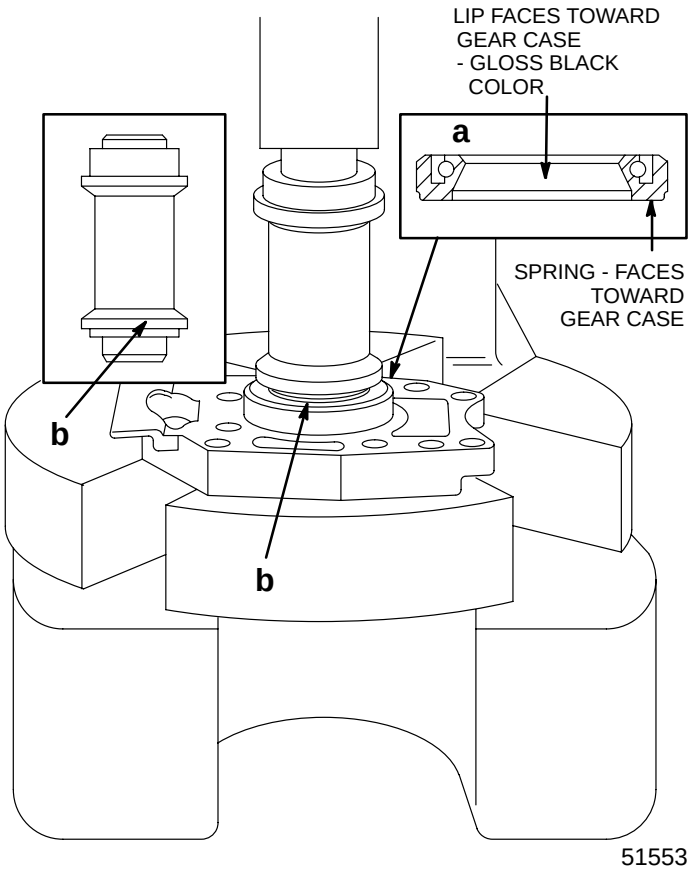
Water Pump Reassembly and Installation

1. Place seal on longer shoulder side of Oil Seal Driver (91-13949) with seal lip away from shoulder.
2. Apply Loctite 271 on O.D. of seal; press seal into water pump base until tool bottoms.



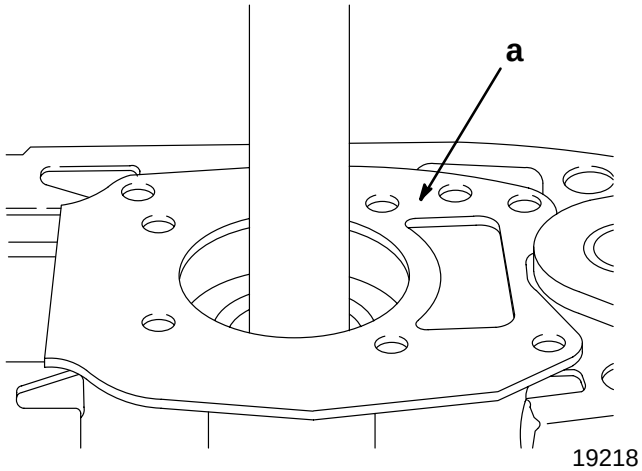
a - Seal
b - Oil Seal Driver (91-13949)

3. Place seal on shorter shoulder side of Oil Seal Driver (91-13949) with seal lip toward shoulder.
4. Apply Loctite 271 on O.D. of seal; press seal into water pump base until tool bottoms.
5. Lubricate lip of each seal with Quicksilver 2-4-C w/ Teflon (92-825407A12).



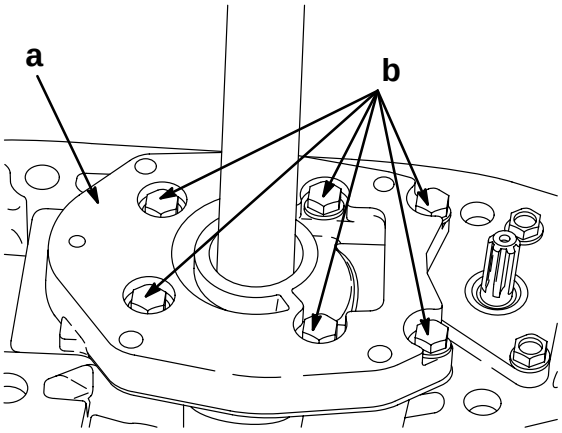
a - Seal
b - Oil Seal Driver (91-13949)

6. Install gasket.



a - Gasket

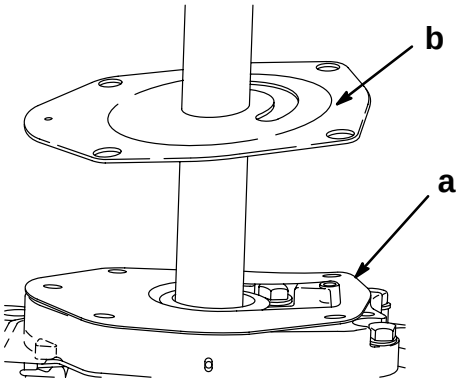
7. Install components as shown.



19217

a - Water Pump Base
b - Bolts and Washers; Apply Loctite 271 on bottom 1/2 ofThreads and Torque to 60 lb. in. (6.5 N·m).

8. Install gasket and plate.

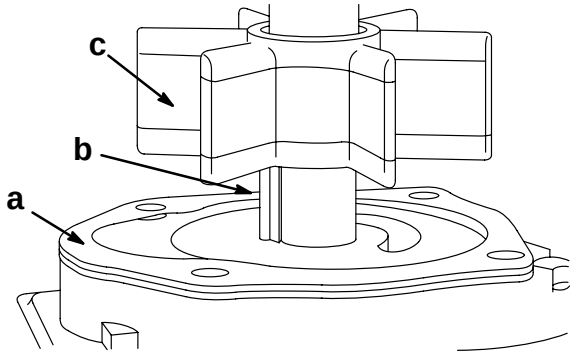


19219

a - Gasket
b - Plate

IMPORTANT: If the old impeller will be re-used, impeller must be installed in original (clockwise) direction of rotation.

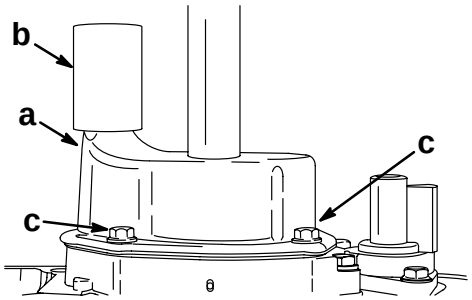
9. Install gasket, drive key and impeller.



19220

a - Gasket
b - Drive Key
c - Impeller

10. Lubricate I.D. of cover with Quicksilver 2-4–C w/ Teflon (92-825407A12).
11. Rotate drive shaft clockwise and push cover down over impeller.
12. Install cover.
13. If water tube seal stayed on water tube (inside of drive shaft housing) when gear housing was removed, pull water tube seal from water tube.
14. Lubricate I.D. of water tube seal with Quicksilver 2-4-C w/Teflon (92-825407A12) and install as shown.



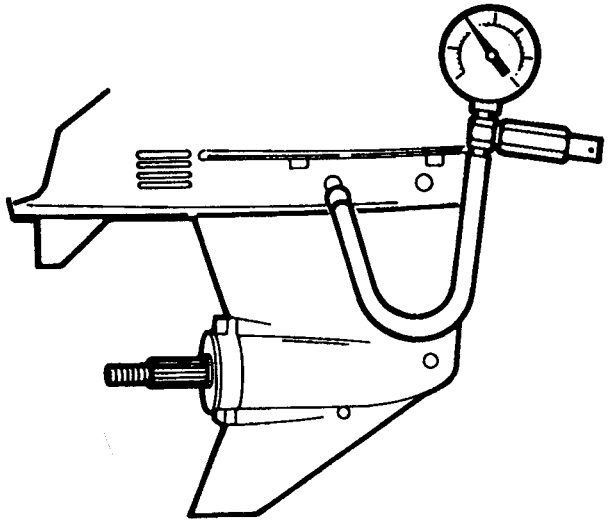
19212

a - Cover
b - Seal
c - Bolts (4); Apply Loctite 271 on Threads and Torque to 60 lb. in. (6.5 N·m).

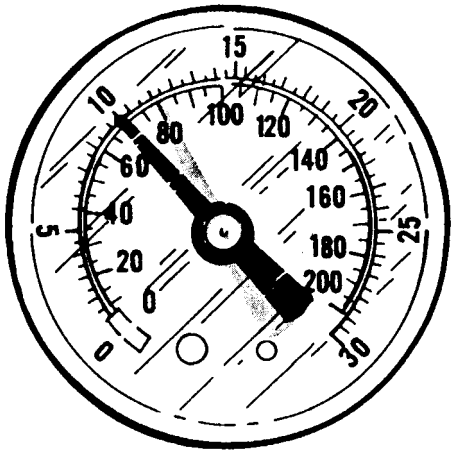
NOTE: *It is recommended that the gearcase be pressure tested for leaks after reassembly and BEFORE gear lube is added. Gearcase should hold 10 to 12 psi for 5 minutes.*

Gear Housing Pressure Test

1. Remove vent plug and install pressure test gauge



2. Pressurized housing to 10 to 12 psi and observe gauge for 5 minutes.
3. Rotate drive shaft,prop shaft and move shift shaft while housing is pressurized to check for leaks.



4. If pressure drop is noted, immerse housing in water.
5. Re-pressurize to 10 to 12 psi and check for air bubbles.
6. Replace leaking seals as necessary. Retest housing.

NOTE: *Gearcase should hold 10 to 12 psi for 5 minutes.*

7. Remove tester from housing and install vent plug.

Filling Gear Housing With Lubricant

NOTE: *Gear housing lubricant capacity is 22.5 fl. oz. (665.2ml).*

⚠ WARNING

If gear housing is installed on engine, to avoid accidental starting, disconnect (and isolate) spark plug leads from spark plugs before working near the propeller.

⚠ CAUTION

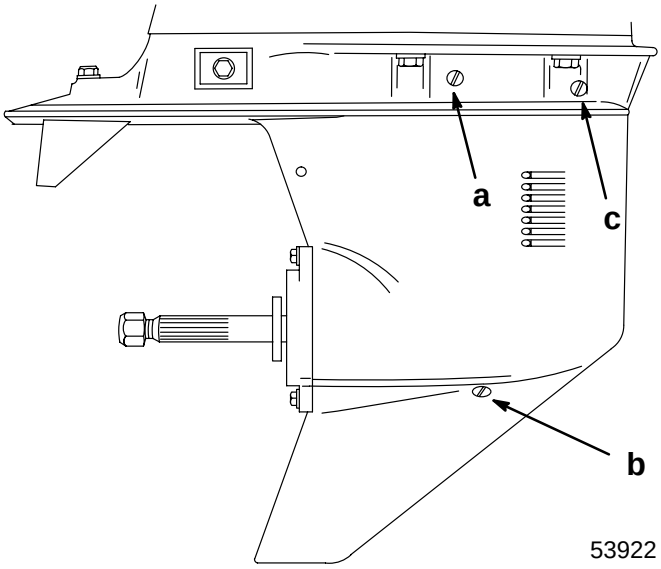
Do not use automotive grease in the gear housing. Use only Quicksilver Gear Lube or Quicksilver Super-Duty Lower Unit Lubricant.

1. Remove any gasket material from “Fill” and “Vent” screws and gear housing.
2. Install new gaskets on “Fill” and “Vent” screws.

IMPORTANT: Never apply lubricant to gear housing without first removing “Vent” screws or gear housing cannot be filled because of trapped air. Fill gear housing only when housing is in a vertical position.

3. Remove lubricant “Fill” screw and gasket from gear housing.
4. Insert lubricant tube into “Fill” hole, then remove “Vent” screws and gaskets.
5. Fill gear housing with lubricant until excess starts to flow out of one (first) “Vent” screw hole.

6. Replace this lubricant “Vent” screw and gasket only and continue filling until excess starts to flow out of second lubricant “Vent” screw hole.



53922

a - Vent Screw
b - Fill/Drain Screw
c - Oil Level Vent Screw

7. Replace second lubricant “Vent” screw and gasket.

IMPORTANT: Do not lose more than one fluid ounce (30cc) of gear lubricant while reinstalling “FILL” screw.

8. Remove lubricant tube from “Fill” hole; install “Fill” screw and gasket.

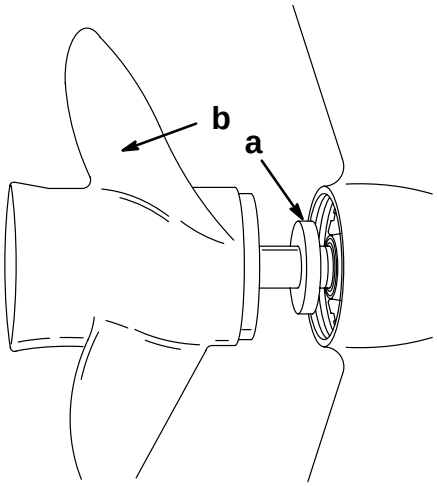
Propeller Installation

⚠ WARNING

If gear housing is not removed from drive shaft housing, before attempting to remove or install the propeller, remove (and isolate) spark plug leads from spark plugs to prevent engine from starting accidentally.

1. Apply a liberal coat of one of the following Quicksilver products on propeller shaft splines:
   - Special Lubricant 101 (P/N 92-13872A1)
   - 2-4-C w/Teflon (92-825407A12)
   - Anti-Corrosion Grease (92-19007A24)

2. Install components as shown.



51801

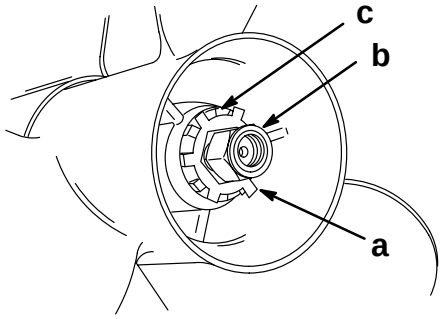
a - Thrust Hub; Flat Surface Toward Propeller
b - Propeller

3. Install tab washer and locknut.
4. Thread locknut onto propeller shaft until locknut is recessed into tab washer.
5. Torque locknut to 55 lbs. ft. (75 N·m).
6. Bend 3 tabs of tab washer down into grooves to secure locknut. If tab washer tabs do not align with slots, continue to tighten locknut to obtain alignment.

⚠ CAUTION

Do not misinterpret propeller shaft movement with propeller movement. If propeller and propeller shaft together move forward-and-aft, this is normal; however, propeller should not move forward-and-aft on propeller shaft.

7. After first use, retighten propeller nut and again secure with tab washer. Propeller should be checked periodically for tightness, particularly if a stainless steel propeller is used.



51871

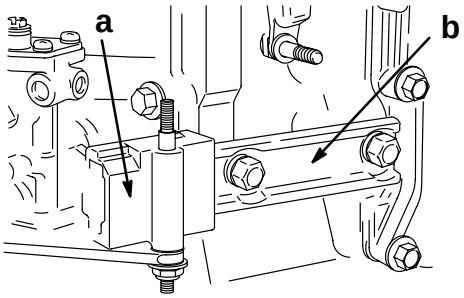
a - Tab Washer
b - Locknut
c - Grooves

Gearcase Installation

⚠ WARNING

Disconnect (and isolate) spark plug leads from spark plugs before installing gear housing onto drive shaft housing. Failure to follow this warning could result in accidental engine starting and possible injury.

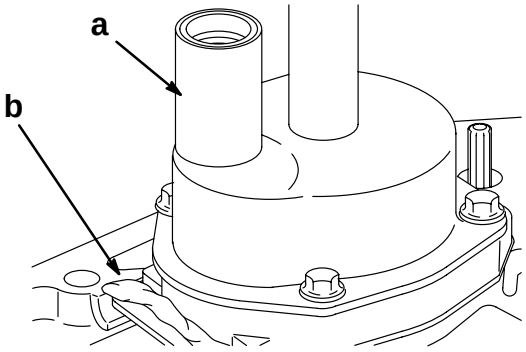
1. Position shift block in forward gear position, as shown.



19879

a - Shift Block; Front of Block MUST Extend 1/8″ (3.2mm) Past Front of Rail.
b - Rail

2. Tilt engine to full up position and engage tilt lock lever.
3. Shift gear housing into neutral position. Propeller shaft will rotate freely in either direction.
4. Install water tube seal; lube I.D. of seal with Quicksilver 2-4-C w/Teflon (92-825407A12).
5. Apply a bead of RTV Sealer as shown.



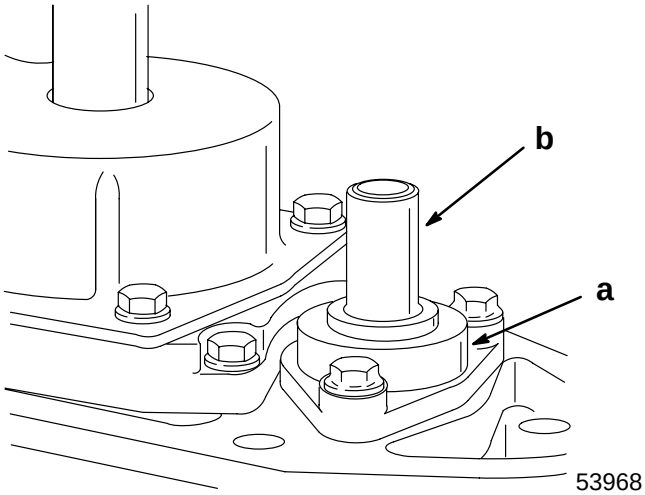
53938

a - Water Tube Seal
b - RTV Sealer

⚠ CAUTION

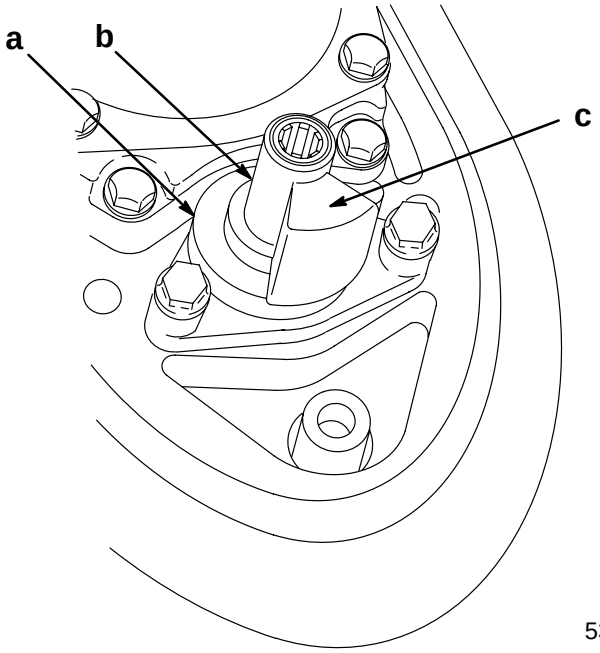
Do not use lubricant on top of drive shaft. Excess lubricant, that is trapped in clearance space, will not allow drive shaft to fully engage with crankshaft. Subsequently, tightening the gear housing fasteners (while lubricant is on top of drive shaft) will load the drive shaft/crankshaft and damage either or both the power head and gear housing. Top of drive shaft is to be wiped free of lubricant.

6. Apply a light coat of Quicksilver 2-4-C w/Teflon onto drive shaft splines.
7. Apply a light coat of Quicksilver 2-4-C w/Teflon on gear case shift shaft splines and upper shift shaft splines. Do not use lubricant on ends of shift shafts.
8. Install components as shown in appropriate photo.



53968

a - Nylon Spacer
b - Shift Shaft Coupler; Used on Models Equipped with Power Trim



53925

a - Nylon Spacer
b - Shift Shaft Coupler; Used on Models NOT Equipped with Power Trim
c - Flat; MUST BE Positioned Toward Front of Gear Housing.

9. Shift gear housing into forward gear position. In forward gear the gear housing will ratchet when propeller shaft is turned clockwise and resistance will be felt when propeller shaft is rotated counter-clockwise.

10. Apply Loctite Grade 271 on threads of gear housing retaining bolts.

NOTE: *If, while performing Step 11, the drive shaft splines will not align with the crankshaft splines, place a propeller onto propeller shaft and turn it counter-clockwise as the gear housing is being pushed toward drive shaft housing.*

NOTE: *During installation of gear housing, it may be necessary to move the shift block (located under cowl) slightly to align upper shift shaft splines with shift shaft coupler splines.*

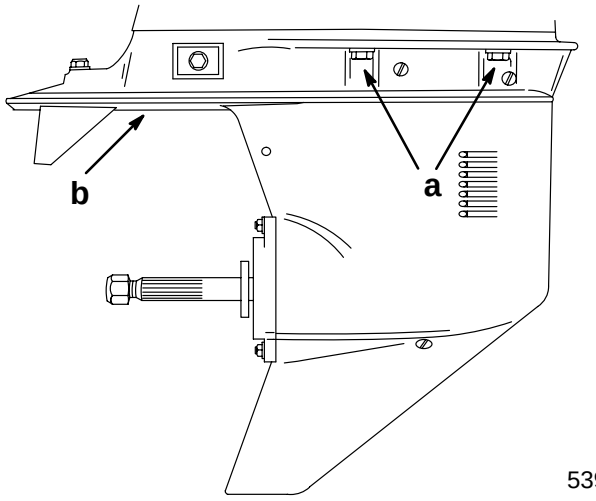
11. Position gear housing so that the driveshaft is protruding into drive shaft housing.

12. Move gear housing up toward drive shaft housing, while aligning upper shift shaft splines with shift shaft coupler splines, water tube with water tube seal, and crank shaft splines with drive shaft splines.

13. Install 4 bolts and washers (two each side).

14. Install locknut and washer.

15. Torque bolts and locknut (or nuts only if applicable) to 40 lbs. ft. (54 N·m).



53922

a - Bolts and Washers (4)
b - Locknut and Washer

16. Check shift operation as follows:

    a. Place shift lever in forward gear. Gear housing should ratchet when propeller shaft is turned clockwise and resistance should be felt when propeller shaft is turned counterclockwise.

    b. Place shift lever in neutral. Propeller shaft should rotate freely in either direction.

    c. While rotating propeller shaft, place shift lever in reverse gear. Resistance should be felt when propeller shaft is rotated in either direction.

IMPORTANT: If shift operation is not as described, preceding, the gear housing must be removed and the cause corrected.

Trim Tab Adjustment

1. Check trim tab position as follows:

    a. Operate boat at the speed at which it normally would be operated.

    b. If the boat pulls to the right (STARBOARD), the trailing edge of trim tab must be moved to the right. If the boat pulls to the left (PORT), the trailing edge of trim tab must be moved to the left.

2. If necessary, adjust trim tab as follows:

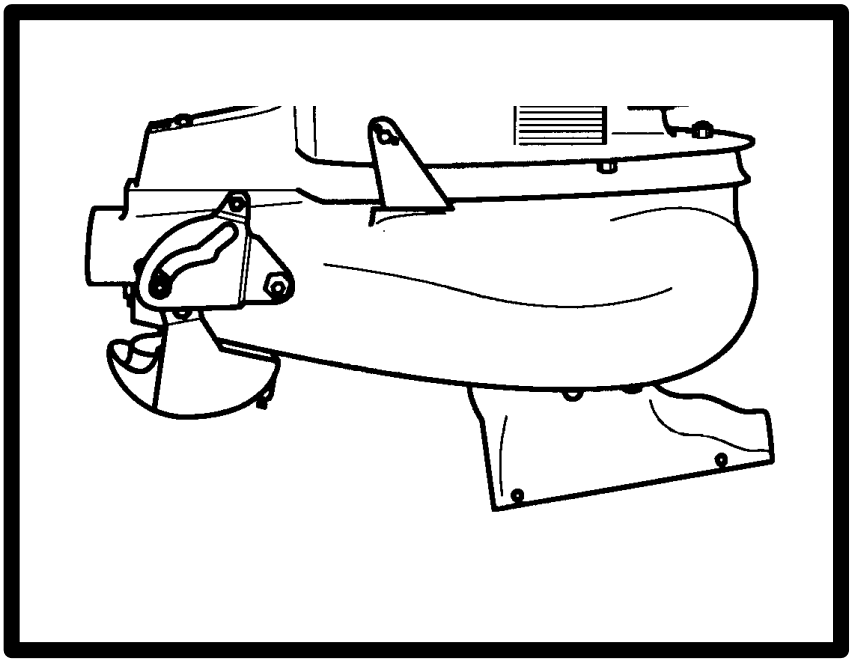
    a. Shift engine control into NEUTRAL and turn ignition key to “OFF” position.

NOTE: *Loosen trim tab bolt sufficiently to allow trim tab to disengage from locking ridges in gear case before attempting to move tab. DO NOT strike trim tab with a hard object to make adjustments.*

    b. If boat pulls to the left, adjust trailing edge of trim tab to the left. If boat pulls to the right, adjust trailing edge of trim tab to the right.

3. Tighten trim tab retaining bolt and washer to 22 lb. ft. (30.0 N·m).

LOWER UNIT



JET DRIVE

6

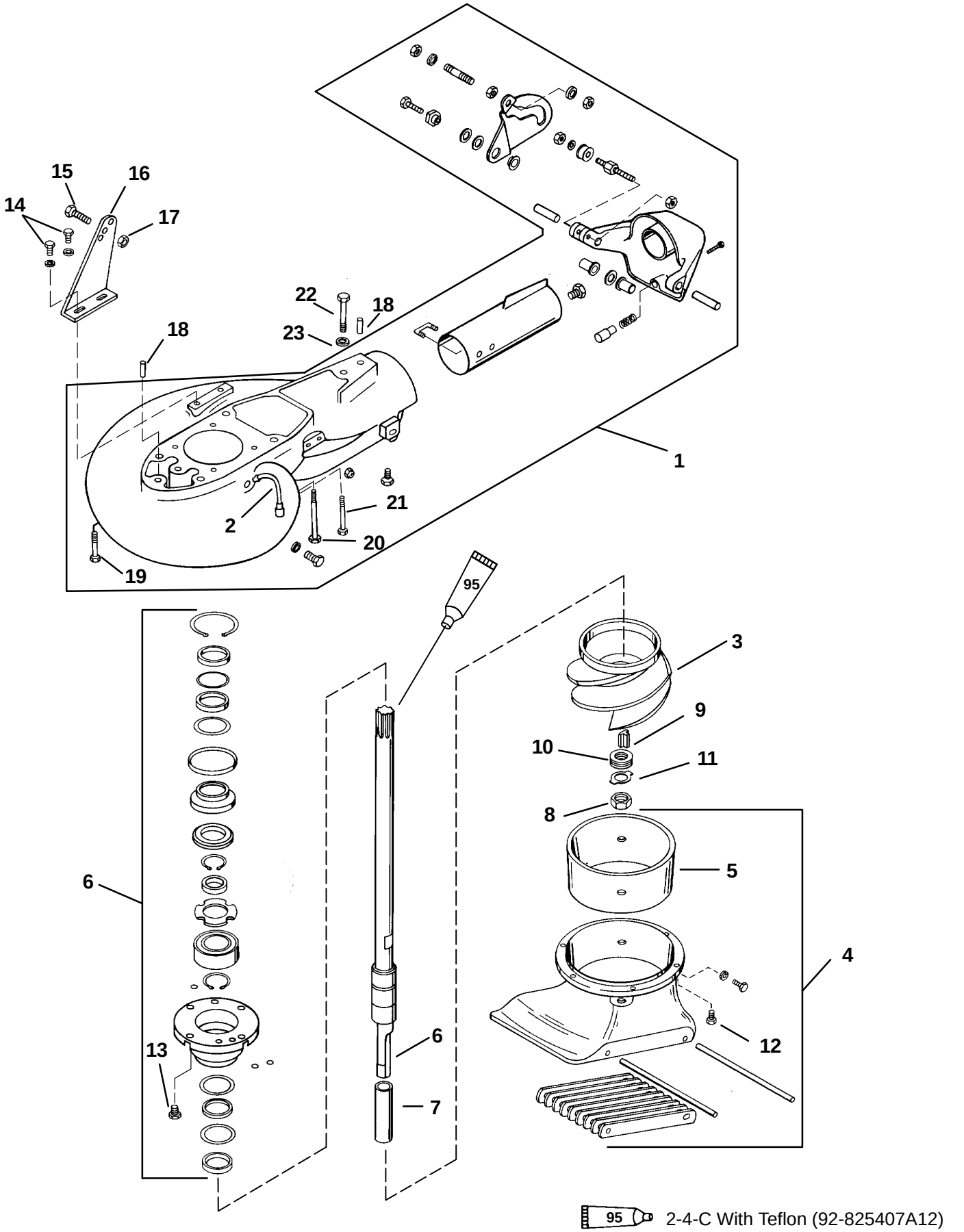
C

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Notes:

JET PUMP ASSEMBLY

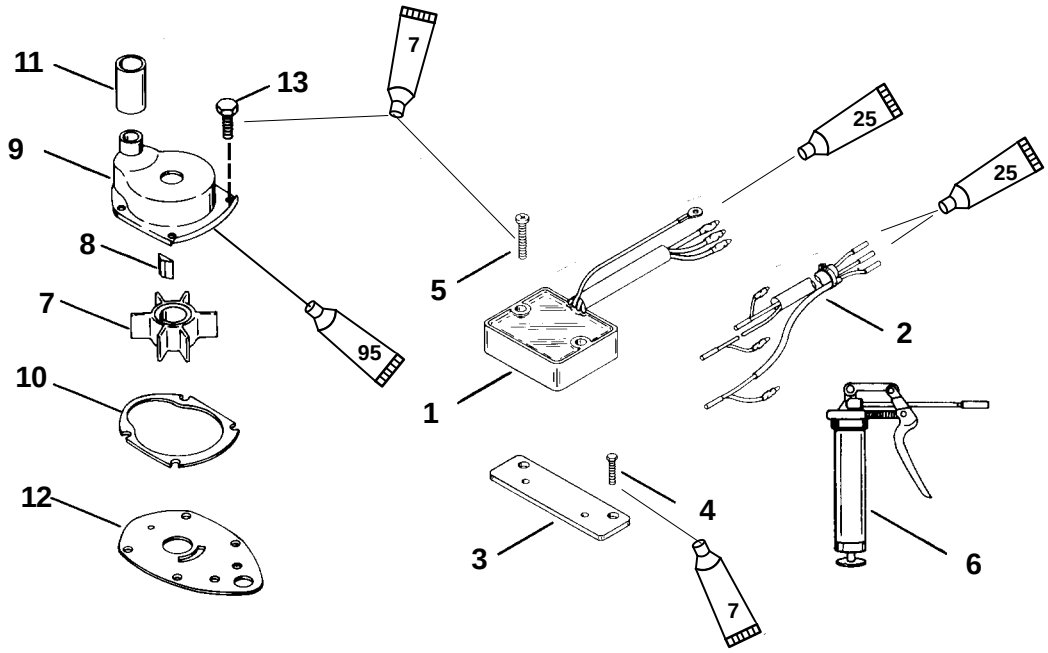


95 2-4-C With Teflon (92-825407A12)

JET PUMP ASSEMBLY

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
–	1	JET PUMP ASSEMBLY			
1	1	HOUSING-Pump			
2	1	HOSE-lube			
3	1	IMPELLER			
4	1	HOUSING-Intake			
5	1	LINER			
6	1	DRIVESHAFT			
7	1	SLEEVE			
8	1	NUT	Drive Tight		
9	1	KEY			
10	8	SHIM			
11	1	TAB WASHER			
12	6	SCREW (1/4-20 x .875)	100		11.5
13	4	SCREW (1/4-20 x .875)	70		8.0
14	2	SCREW (1/4-20 x .625)	70		8.0
15	1	SCREW (.312-18 x 1.25)		13	17.5
16	1	BRACKET			
17	1	NUT		13	17.5
18	2	PIN-Dowel			
19	2	SCREW (M10 x 60)		25	34.0
20	1	SCREW (M10 x 90)		25	34.0
21	1	SCREW (M10 x 70)		25	34.0
22	1	SCREW (.375-16 x .75)		22.5	30.5
23	1	WASHER			

JET COMPONENTS



7 Loctite 271 (92-809820)

25 Liquid Neoprene (92-25711--2)

95 2-4-C With Teflon (92-825407A12)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	REV LIMITER			
2	1	HARNESS–Adaptor–Rev Limiter			
3	1	BRACKET			
4	2	SCREW (M6 x 16)	70		8.0
5	2	SCREW (M5 x 25)	70		8.0
6	1	GREASE KIT			
7	1	IMPELLER			
8	1	KEY			
9	1	WATER PUMP			
10	1	GASKET (UPPER)			
11	1	SEAL			
12	1	FACE PLATE			
13	4	SCREW	60		7.0

Selecting A Boat That Is Best Suited For Jet Power

Too obtain the best performance from the jet drive, the boat should have the following features:

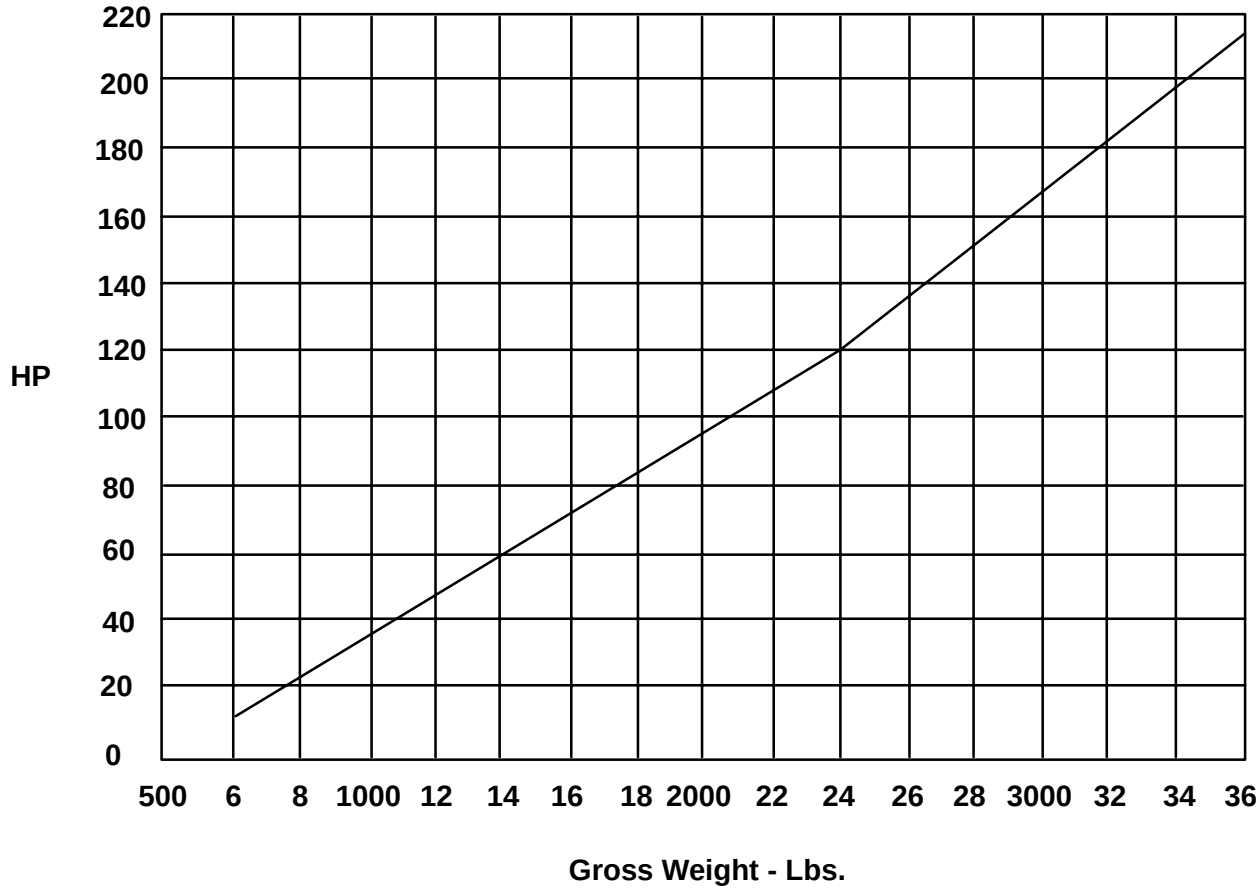
1. The boat should be as light as possible.
2. The boat should have hull and transom that is designed for use with a jet drive.
3. The boat should be at least 13 feet in length.

Engine Horsepower Selection

A boat operating at slow speed requires considerably more depth than one which is planing on the surface of the water. It is important therefore to use sufficient horsepower and not to overload your boat beyond its ability to plane. See the following table.

Engine Horsepower Selection

The following table is based on experience obtained with sled-type boats using outboard jets. The gross weights shown includes the outboard, boat, people, and all the gear carried. For a given horsepower loading beyond these weights will give less than good performance.



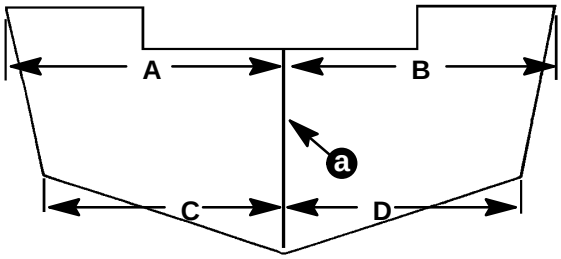
Transom height of the boat

Outboards with jet drives will be mounted approximately 7 inches higher on the transom than propeller driven outboards. This requires outboards that have a 15 in. shaft length to be installed on boats having a 22 in. transom height and outboards that have a 20 in. shaft length to be installed on boats having a 27 in. transom height.

If the boat transom is of insufficient height, and the outboard cannot be installed to the recommended height, contact the boat manufacturer for recommended procedure to build up the boat transom.

Locate Center line Of The Outboard

Locate (and mark with pencil) the vertical centerline (a) of boat transom.



a - Centerline of Transom

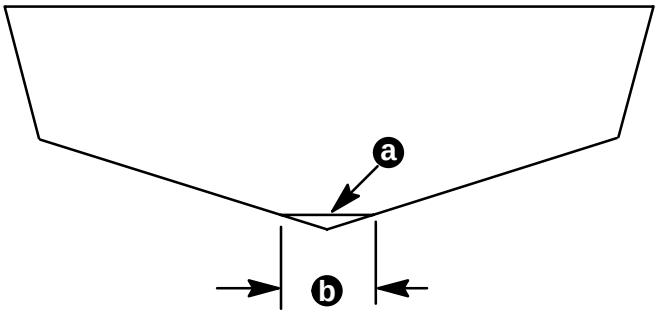
Outboard Mounting Height

The initial outboard mounting height setting will work good for most applications, however, because of different boat/hulls designs, the setting should be rechecked by test-running the boat. Refer to Water Testing.

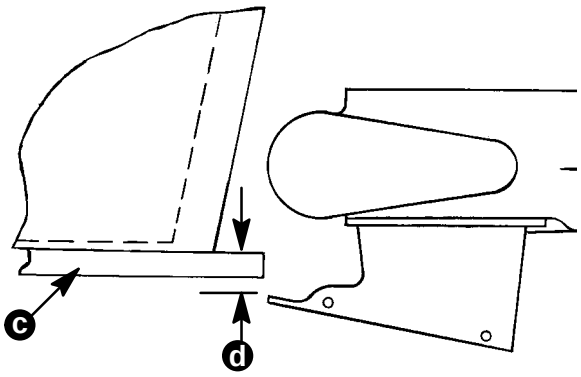
- Installing the outboard too high on the transom will allow the water intake to suck in air and cause cavitation. (cavitation will cause the engine to overspeed in spurts and reduce thrust). This condition should be avoided by proper height setting.
- Installing the outboard too low on the transom will allow excessive drag.

SETTING OUTBOARD MOUNTING HEIGHT ON BOATS WITH "V" BOTTOM HULLS

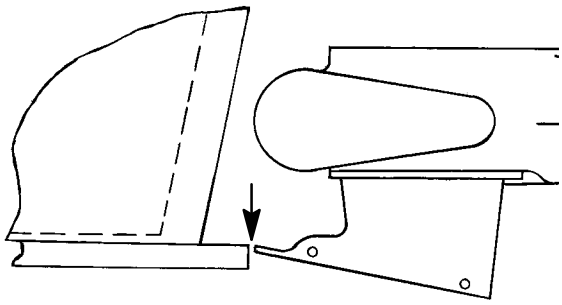
1. Measure the width of the leading edge on the water intake housing. Make a horizontal line (a) on the transom up from the "V" bottom the same length as the width of the water intake housing (b).



2. Place (center) the outboard on the boat transom so that the transom brackets are resting on top of the transom. Temporally fasten the outboard to the transom using two C-clamps.
3. Position the outboard in a vertical position.
4. Line-up a straight edge (c) along the bottom of the boat with the horizontal line made in Step 1 and measure the distance between the horizontal line and top front edge of the water intake housing (d).



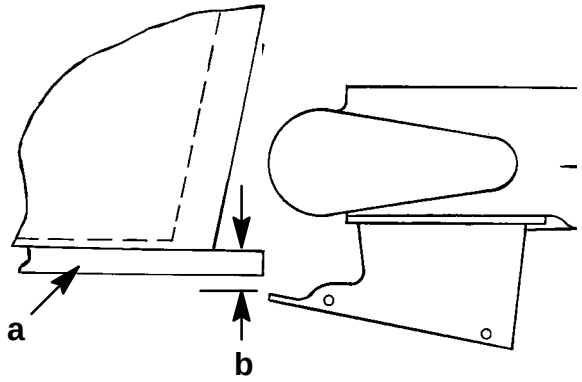
5. Raise The outboard up on the transom the distance measured in Step 4. Use a straight edge and recheck the mounting height. The top edge of the water intake housing should be lined-up with the horizontal line made in Step 1.



6. Fasten outboard to the transom at this height.

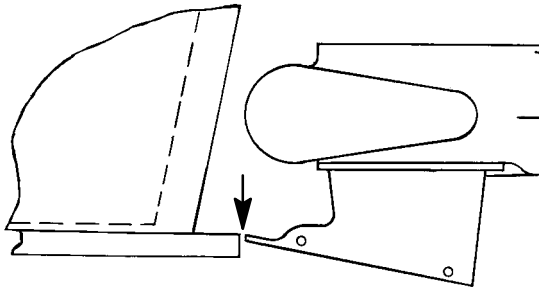
SETTING OUTBOARD MOUNTING HEIGHT ON BOATS WITH FLAT BOTTOM HULLS

1. Place (center) the outboard on the boat transom so that the transom brackets are resting on top of the transom. Temporally fasten the outboard to the transom using two C-clamps.
2. Position the outboard in a vertical position.
3. Place a straight edge (a) along the bottom of the boat as shown and measure the distance between the bottom of the boat and top front edge of the water intake housing (b).



a - Straight Edge
b - Top Edge of Water Intake Housing

4. Raise The outboard up on the transom the distance measured in Step 3. Use a straight edge and recheck the mounting height. The top edge of the water intake housing should be in line with the bottom of the boat as shown.



5. Fasten outboard to the transom at this height.

Water testing

Checking for Cavitation

Making the initial outboard height setting should be close to the optimum setting for the outboard. However because of the hull design of some boats, obstructions or imperfections in the hull ahead of the water intake may require this setting to change in order to prevent cavitation at running speeds.

When operating the boat, the outboard drive shaft should be vertical when planing or tilted toward the boat in order to provide a scooping angle on the water intake. Tilting the outboard out beyond a vertical position reduces the scoop angle and can cause impeller slippage and cavitation. If the angle of the boat transom does not allow the drive shaft to be positioned vertical a Wedge kit should be installed behind the transom brackets to increase the tilt-in angle.

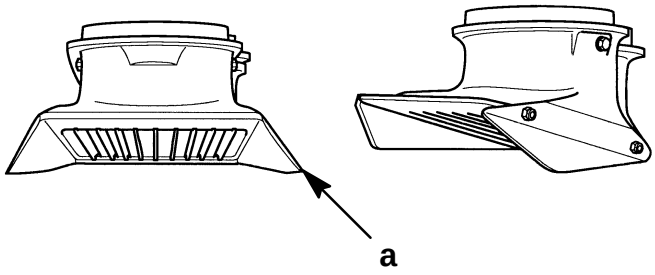
NOTE: *Slight cavitation in sharp turns and rough water is acceptable but excessive cavitation is harmful to the outboard and should be avoided.*

Test run the boat. If cavitation occurs (air enters the pump causing loss of thrust, engine over-speeds erratically). the first thing to try is lowering the outboard height 1/4 in. This can be accomplished by elongating the drilled mounting holes in the boat transom by 1/4 in.

If cavitation still exists after lowering the outboard 1/4 in., it maybe helpful to seek advice from the boat manufacturer.

A number of other options are available to further reduce cavitation.

1. Water intake fin kit (a) – Available from the Specialty Mfg. Co. for jet models 30 thru 140. The purpose of these fins is to ram more water into the intake and shield the forward sides of the intake from the entrance of air. This kit will help reduce cavitation when running with the wind in a chop.



a - Intake Fin Kit

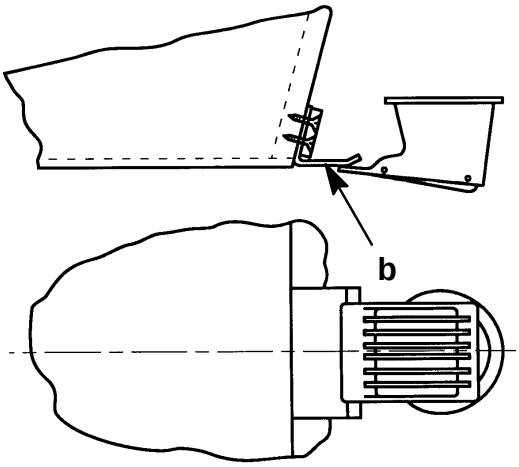
Water Intake Fin Kit Part No.1186 for jet models 45 thru 140 and Part No. 1185 for jet model 30 is available from.
Specialty Mfg. Co.
2035 Edison Ave.
San Leandro, CA 94577

Continued on next page

Water testing

Checking for Cavitation (Continued)

2. Rough Water Plate (b) – Using this type of plate may be helpful in reducing cavitation when running in windy rough water conditions where air is sucked-in the water intake when jumping waves. Install a 1/32 in. metal plate that extends from the hull bottom to the top of the water intake housing. This plate tends to reduce air intake as well as reduce spray.



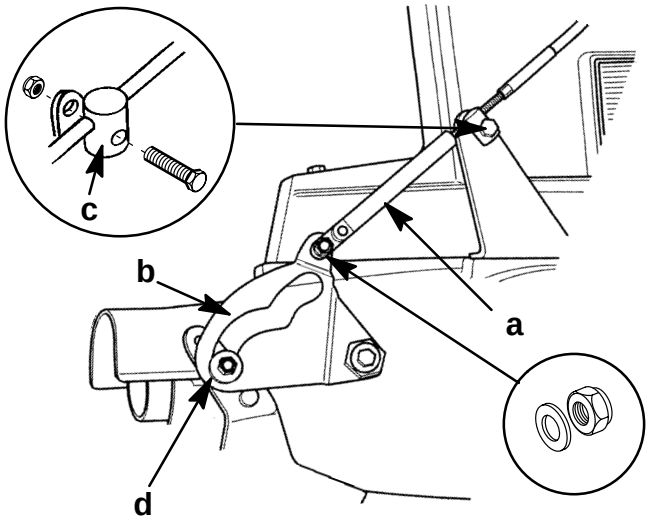
b - Rough Water Plate

Shift Cable Installation

⚠ WARNING

The shift cable must be adjusted to lock the reverse gate against unexpected engagement (caused by water pressure hitting the gate) while operating the boat in forward. Activation of the reverse gate will cause sudden unexpected stopping of the boat. Sudden stopping may cause occupants to be thrown within the boat or even out of the boat. This action may result in serious injury or death.

1. Attach shift cable (a) to the shift cam (b) with flat washer and locknut as shown. Tighten locknut against the flat washer, then back-off the locknut 1/4 turn.
2. Place remote control handle into full forward position.
3. Adjust the brass barrel (c) on the shift cable so that roller (d) is at the full end of travel (bottom) in the shift cam when the remote control is in full forward.
4. Attach the brass barrel (c) to the bracket with bolt and locknut. Tighten the bolt until it seats against the barrel, then back-off the bolt 1/4 turn. Hold bolt from turning, and tighten locknut on bolt. The barrel must be free to pivot.



a - Shift Cable
b - Shift Cam
c - Barrel
d - Roller

5. Recheck the shift cable adjustment in forward shift position. The correct shift adjustment will position the cam far enough on the roller in order to lock the the reverse gate into forward position. You should not be able to forcibly push up the reverse gate toward neutral. Pull on the reverse gate by hand to verify this.

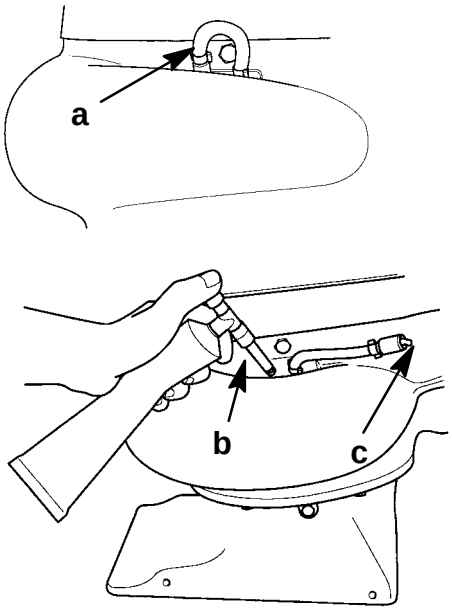
IMPORTANT: The forward locking of the reverse gate must be met. If not, readjust the shift cable.

Lubricating The Drive Shaft Bearing

Recommended Lubrication - Use 2-4-C w/Teflon.

IMPORTANT: It is important that you do not use a general-all-purpose grease for this bearing. The lubricant we recommend is a water resistant grease of the proper consistency for this application. If you use a substitute grease, be sure that it is water resistant and of the same consistency.

Frequency of lubrication - We recommend lubricating the drive shaft bearing after each day's use and after every 10 hours of operation. After every 30 hours of operation, pump in extra grease to purge out any moisture.



a - Vent Hose
b - Grease Gun
c - Grease Exiting Vent Hose

Lubricating Procedure - Pull vent hose (a) off the grease fitting. Pump in grease through the grease fitting (using the grease gun (b) provided) until excess grease starts to exit the vent hose (c).

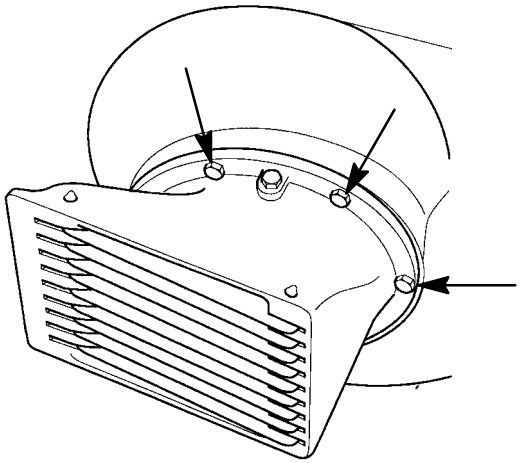
Reconnect the vent hose (a) onto the grease fitting after greasing.

After 30 hours of operation, pump in extra grease to purge out any moisture. Visually inspecting the purged grease at this time will give you an indication of conditions inside the bearing housing. A gradual increase in moisture content, indicates seal wear. If the grease begins to turn dark, dirty gray, the drive shaft bearing and seals should be inspected and replaced if necessary. Some discoloration of the grease is normal during the break-in period on a new set of seals.

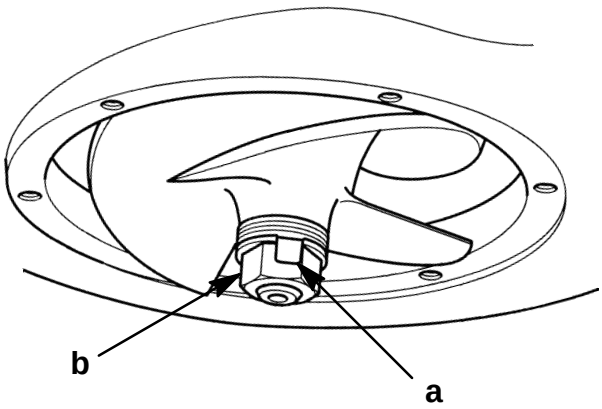
Impeller Removal and Installation

REMOVAL

1. Shift outboard to NEUTRAL (N) position.
2. Remove spark plug leads to prevent engine from starting.
3. Remove the water intake housing that is fastened with six screws.



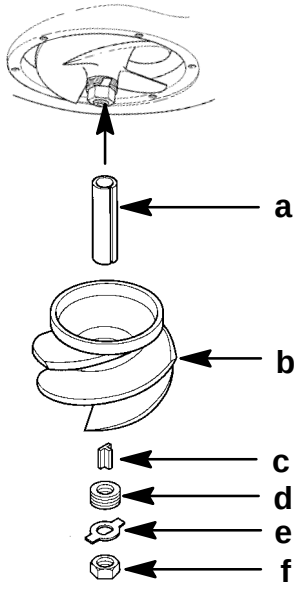
4. Straighten the bent tabs (a) on the impeller nut retainer and remove the impeller nut (b).
5. Pull impeller straight off the shaft. If the impeller is tight, use a hammer and block of wood to rotate the impeller (clockwise) on the shaft until the keyway is directly above the flat on the shaft. This will free the jammed key and allow removal.



a - Tab
b - Nut

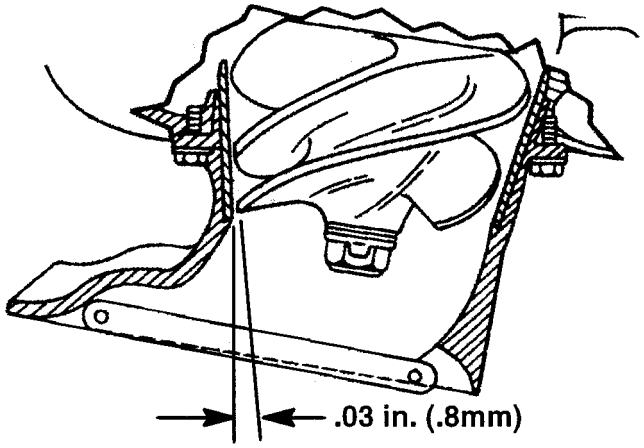
INSTALLATION

1. Grease the drive shaft, shear key, and impeller bore. Place the plastic sleeve (a) inside the impeller (b) and install impeller, shear key (c), shims (d) nut retainer (e), and impeller nut (f). Turn the nut tight on the shaft to remove any play between the impeller and shaft. If the tabs on the retainer do not line up with the flats on the nut, remove the nut and turn the retainer over and re-tighten the nut again.

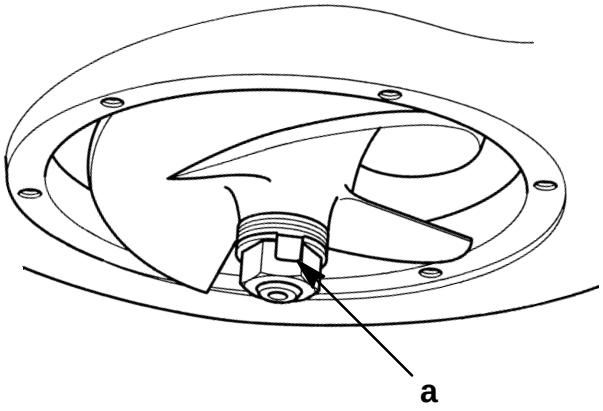


a - Plastic Sleeve
b - Impeller
c - Shear Key
d - Shims
e - Nut Retainer
f - Impeller Nut

2. Temporarily reinstall the water intake housing in order to check for impeller clearance. The clearance between the impeller and liner should be 0.030 in. (0.8 mm). Shim washers can be transferred to either side of the impeller to raise or lower the impeller to the correct clearance setting. The water intake housing can be shifted side ways a small amount in order to center the liner.



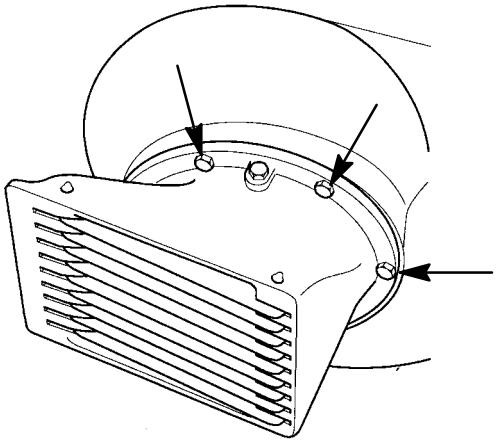
3. After setting the impeller height, tighten the impeller nut snug with a wrench. Secure impeller nut by bending tabs (a) against the flats on the impeller nut.



a - Tabs

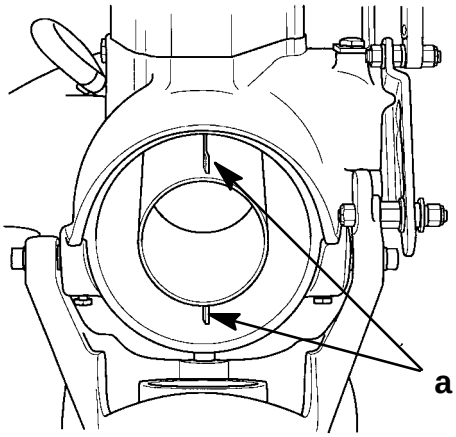
4. Reinstall the water intake housing with six bolts. Check clearance around the impeller to make sure the water intake housing is centered and not rubbing against the liner. Torque mounting bolts to 100 lb. in. (11.2 N·m).

NOTE: *If the outboard is used in salt water, apply Quicksilver Anti-Corrosion Grease around the entire mounting flange on the water intake housing and also to the threads on the six mounting bolts.*



Steering Pull Adjustment

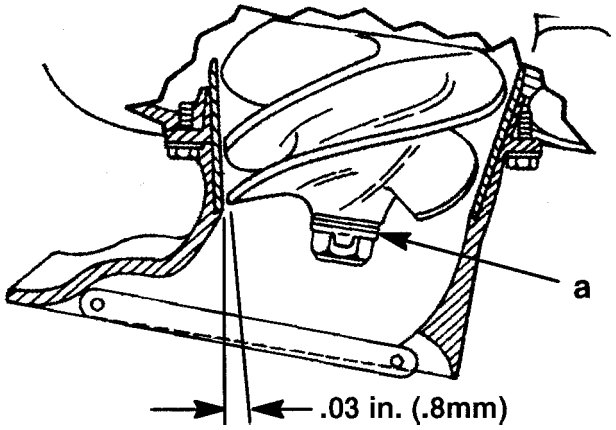
The steering on some boats will have the tendency to pull towards starboard. This pulling condition can be corrected by using a pliers and bending the ends of the exhaust fins (a) 1/16 in. (1.5mm) toward the starboard side of the outboard.



a - Exhaust Fins

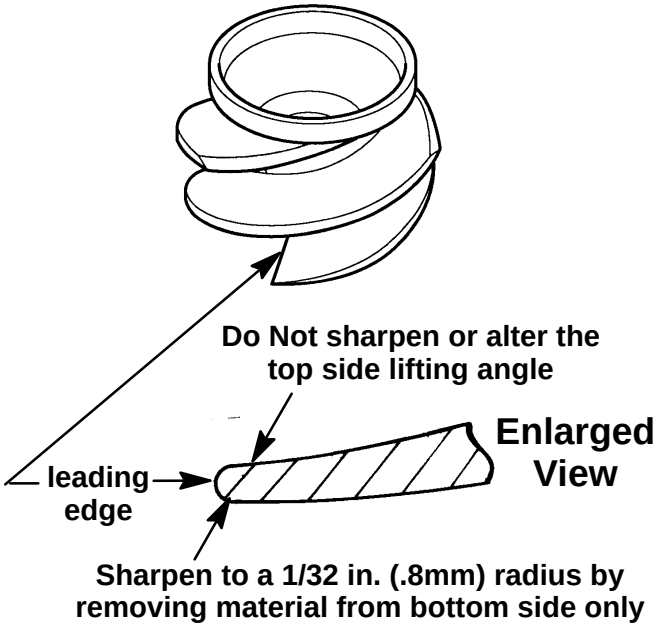
Impeller Clearance Adjustment

1. The impeller should be adjusted so there is approximately 0.03 in. (0.8mm) clearance between the impeller edge and liner. Operating the jet drive in waters that contain sand and gravel can cause wear to the impeller blades, and the clearance will start to exceed 0.03 in. (0.8mm). As the blades wear, shims (a) located in the stack outside of the impeller can be transferred behind the impeller. This will move the impeller further down into the tapered liner to reduce the clearance.
2. Check the impeller clearance by sliding a feeler gauge through the intake grate and measure the clearance between the impeller edge and liner. If adjustment is required, refer to Impeller Removal and Installation.



a - Shims

Worn (Dull) Impeller

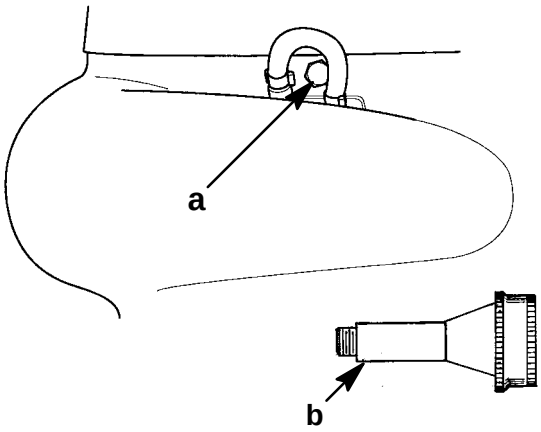

Do Not sharpen or alter the top side lifting angle
leading edge
Enlarged View
Sharpen to a 1/32 in. (.8mm) radius by removing material from bottom side only

The intake of gravel through the pump can round off and wear the leading edges on the impeller. Some conditions you may experience from a worn impeller are (1) a noticeable performance loss, especially on acceleration, (2) difficultly getting the boat on plane, or (3) an increase in engine RPM at wide open throttle. Check the impeller blades occasionally for damage. Use a flat file to resharpen the leading edges as shown.

Flushing The Cooling System

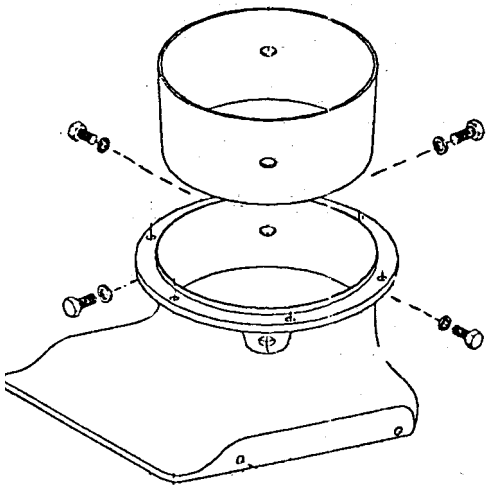
Use Quicksilver accessory hose coupling Part Number 24789A1.

1. Remove plug and gasket (a) and thread-in hose coupling (b).
2. Attach a water hose to the hose coupling. Turn on the water gently, start the engine, and run it at idle speed only.
3. Check for a steady stream of water flowing out of the water pump indicator hole. Continue flushing the outboard for 3 to 5 minutes; adjust water pressure if needed.
4. Stop the engine, turn off the water, and remove the hose coupling. Reinstall the plug and gasket.



a - Plug and Gasket
b - Hose Coupling

Liner Replacement



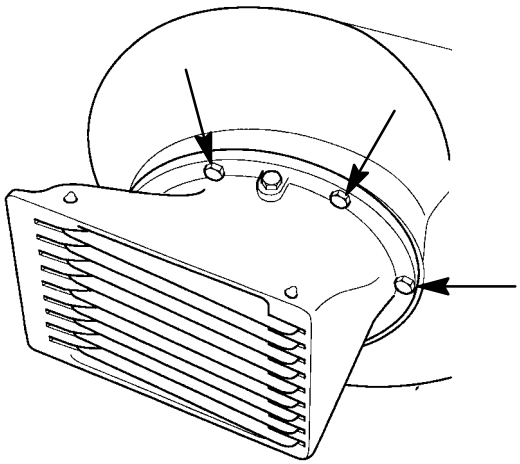
1. Mark the liner mounting bolts for reassembly into the same holes. Remove the bolts.
2. Remove the liner. If the liner is tight, tap on the inner edge of the liner with a long drift punch through the intake grate.

NOTE: *Apply grease to the liner mounting bolt threads before assembly.*

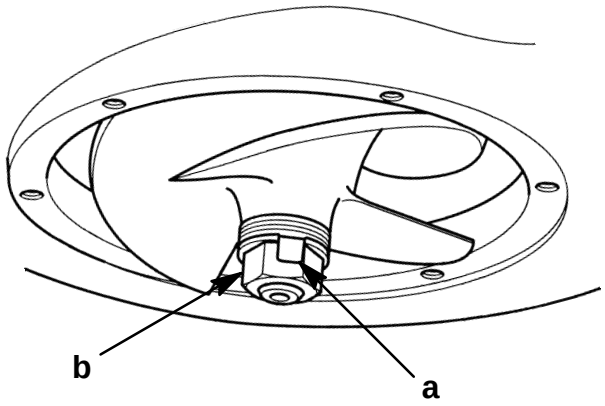
3. Position the liner into the water intake housing. Line up one of the liner bolts and lightly thread it in. It may be necessary to tap or press the liner into the water intake housing to locate the liner for installation of the remaining bolts. Torque bolts to 100 lbs. in. (11.2 N·m)
4. Grind off the ends of any bolts that may extend beyond the inner liner surface.

Jet Drive Removal

1. Shift outboard to NEUTRAL (N) position and disconnect the shift linkage.
2. Remove spark plug leads to prevent engine from starting.
3. Remove the water intake housing that is fastened with six screws.

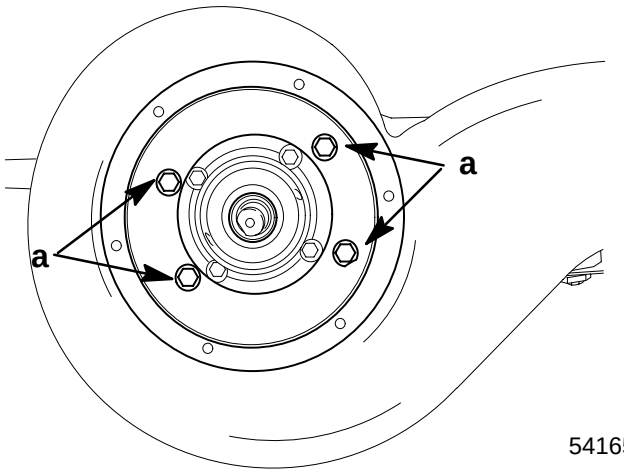


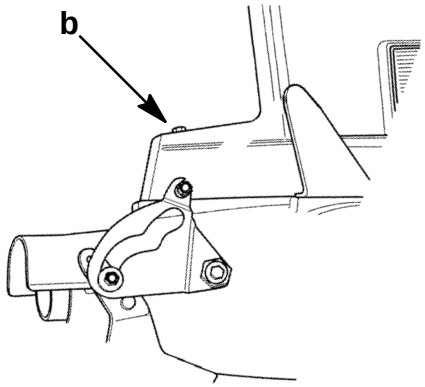
4. Straighten the bent tabs (a) on the impeller nut retainer and remove the impeller nut (b).
5. Pull impeller straight off the shaft. If the impeller is tight, use a hammer and block of wood to rotate the impeller (clockwise) on the shaft until the keyway is directly above the flat on the shaft. This will free the jammed key and allow removal.



a - Tabs
b - Nut

6. Remove 5 bolts securing jet drive to drive shaft housing and remove pump.



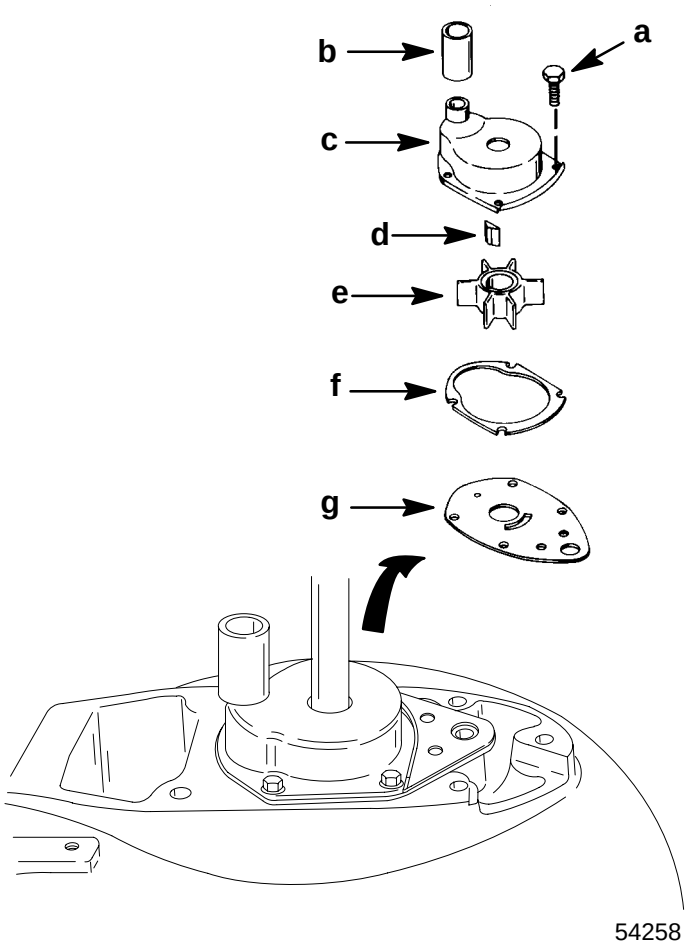


a - Bolts (4)
b - Bolt (1)

Bearing Carrier Removal

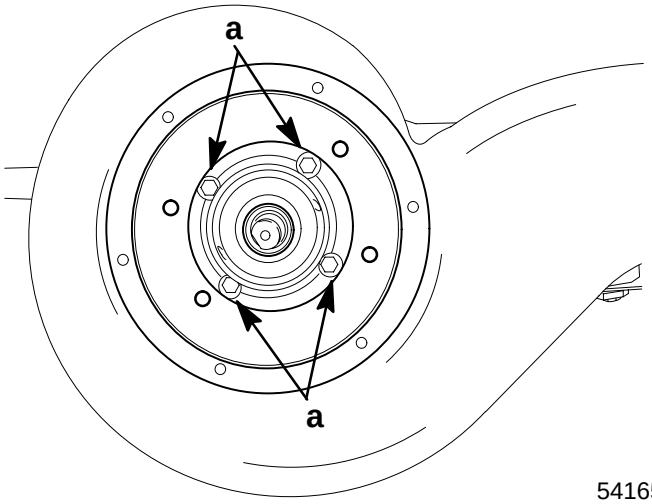
NOTE: *Water pump assembly must be removed before bearing carrier can be removed.*

1. Remove 4 bolts securing water pump assembly and remove water pump.



a - Bolts (4)
b - Seal
c - Housing
d - Key
e - Impeller
f - Gasket
g - Plate

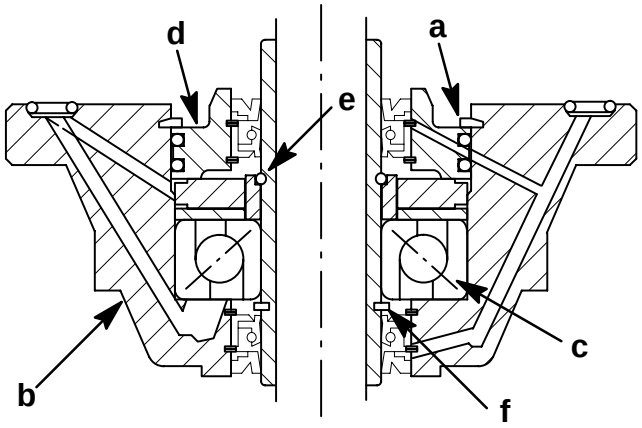
2. Remove 4 bolts securing bearing carrier to jet drive.



a - Bolts

Bearing Carrier Disassembly

1. Remove the large beveled snap ring (a) from the bearing carrier.
2. Heat the bearing carrier (b) with a torch only until you can barely touch it.
3. Hold the drive shaft vertical and bump the impeller end of the drive shaft against a wooden block causing the bearing carrier to slide down off the bearing.
4. Remove snap ring (e), press the ball bearing (c) off the drive shaft. Leave the bearing thrust ring (f) (located in the drive shaft groove) unless damaged.
5. Remove the seals and spiral retaining rings from the bearing carrier and the upper seal housing (d).
6. Clean all parts thoroughly and remove any burrs.



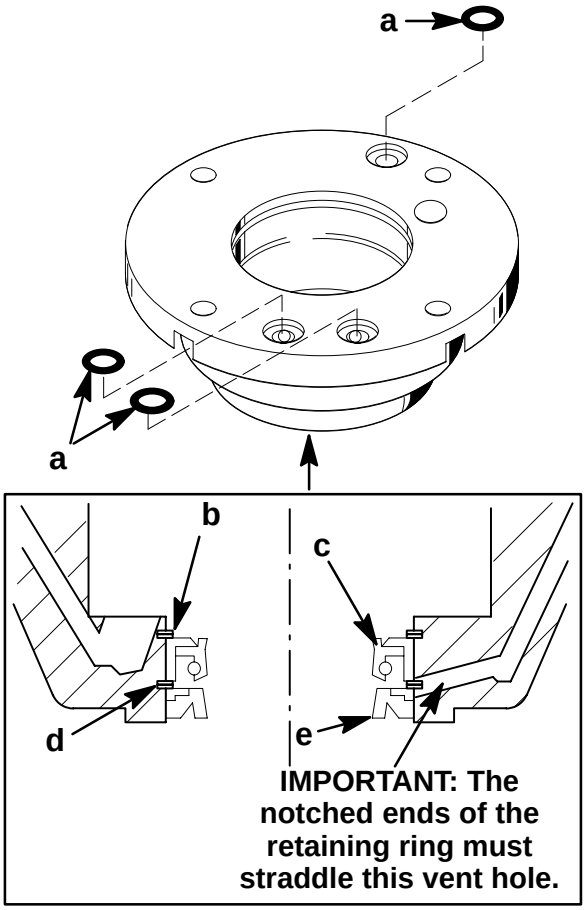
a - Snap Ring
b - Bearing Carrier
c - Ball Bearing
d - Upper Seal Housing
e - Snap Ring
f - Thrust Ring

Bearing Carrier Reassembly

Installing Lower Seals

Install seals into bearing carrier as follows:

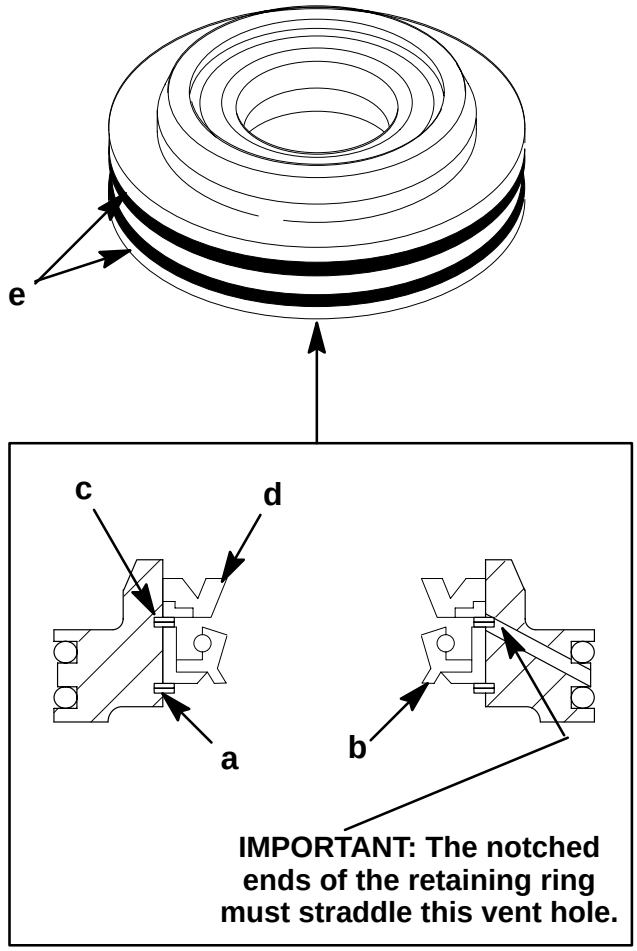
1. Install O-ring seals (a) into the top seats of the three passage holes.
2. Install spiral retaining ring (b) into the inner ring groove.
3. Spread a film of grease around the inside bore of the seal surface before pressing in the seals.
4. Press in the garter spring seal (c) against the inner retaining ring as shown. Fill the garter spring cavity in the seal with grease.
5. Install spiral retaining ring (d) into the outer ring groove. Align the notched ends of the retaining ring to straddle the small vent hole drilled in the ring groove.
6. Press in the outer seal (e) against the retaining ring as shown.
7. Grease all the seal lips.



a - O-rings
b - Retaining Ring
c - Spring Seal
d - Retaining Ring
e - Outer Seal

Installing Upper Seals

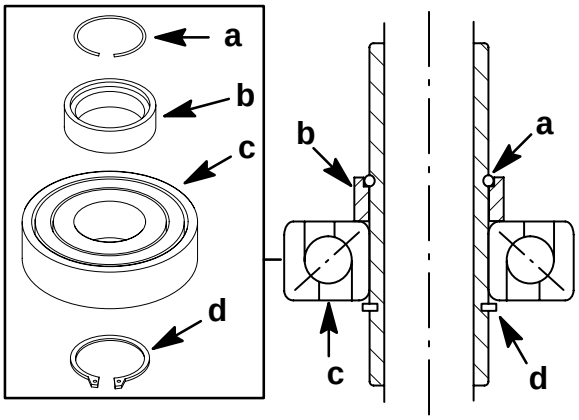
1. Install spiral retaining ring (a) into the inner ring groove of the upper seal housing.
2. Spread a film of grease around the inside bore of the seal surface before pressing in the seals.
3. Press in the garter spring seal (b) against the inner retaining ring as shown. Fill the garter spring cavity in the seal with grease.
4. Install spiral retaining ring (c) into the outer ring groove. Align the notched ends of the retaining ring to straddle the small vent hole drilled in the ring groove.
5. Press in the outer seal against the retaining ring as shown.
6. Grease all the seal lips.
7. Grease the two O-ring seals (e) and install then into the outer ring grooves.



a - Retaining Ring
b - Spring Seal
c - Retaining Ring
d - Outer Seal
e - O-rings

Installing Drive Shaft Ball Bearing

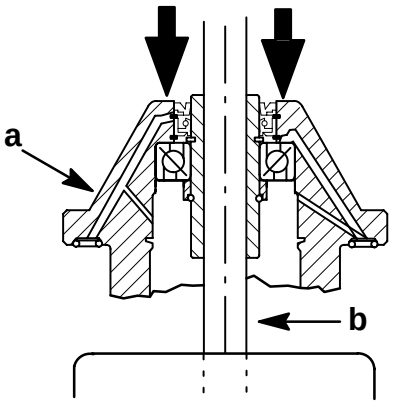
1. If removed, install the bearing thrust ring (a) into the groove on the drive shaft.
2. Install collar (b) onto the drive shaft. Press the new ball bearing (c) onto the drive shaft, **pressing against the inner race only**. Press collar (b) over the thrust ring (a), locking it in its groove. Install snap ring (d) into drive shaft groove below the bearing.



Installing Drive Shaft

1. Lubricate the seals and inside bore of the bearing carrier (a).
2. Place the drive shaft (“b” impeller end facing up) into a vise.
3. Heat the bearing carrier (a) until it feels warm to the touch.
4. Place the bearing carrier (a) onto the drive shaft. Square up the inner bore with the ball bearing and push the bearing carrier down until it bottoms-out against the bearing. It may be necessary to lightly tap bearing carrier onto the bearing using a rubber hammer.

NOTE: *Only a light pressing force is needed to press on the bearing carrier. It may be necessary to lightly tap the bearing carrier onto the bearing using a rubber hammer.*

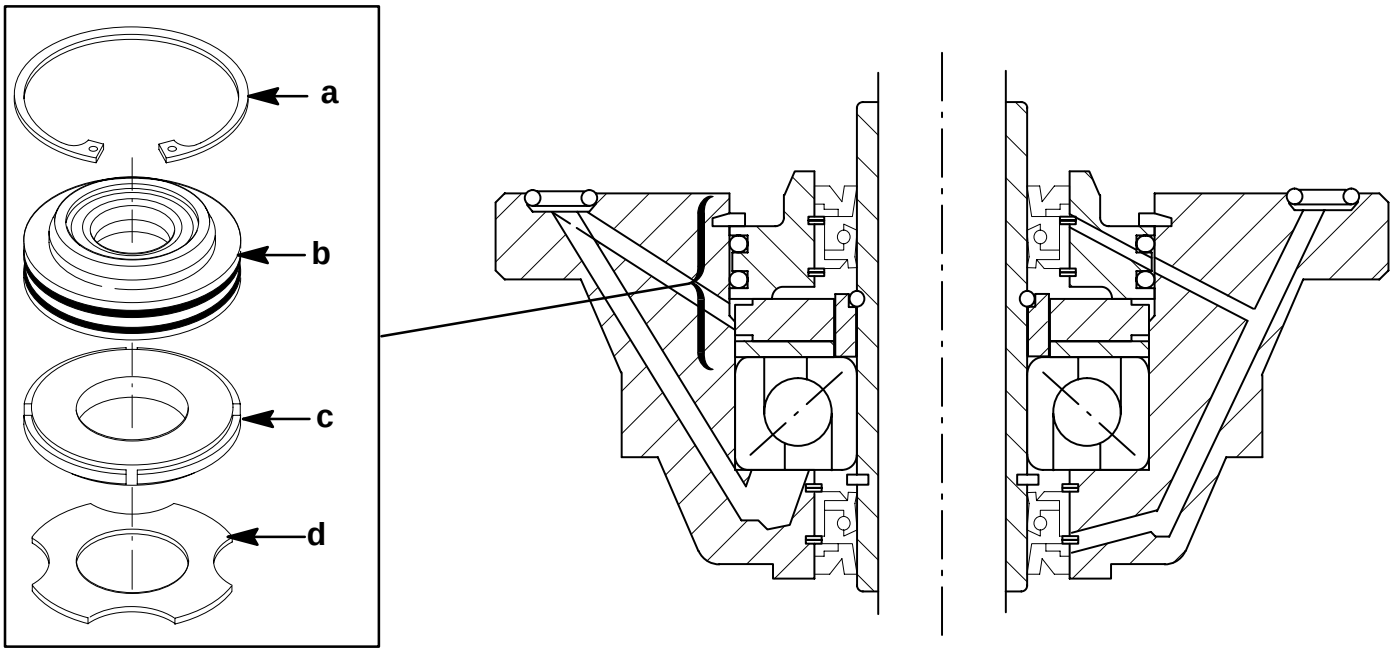


a - Bearing Carrier
b - Drive Shaft

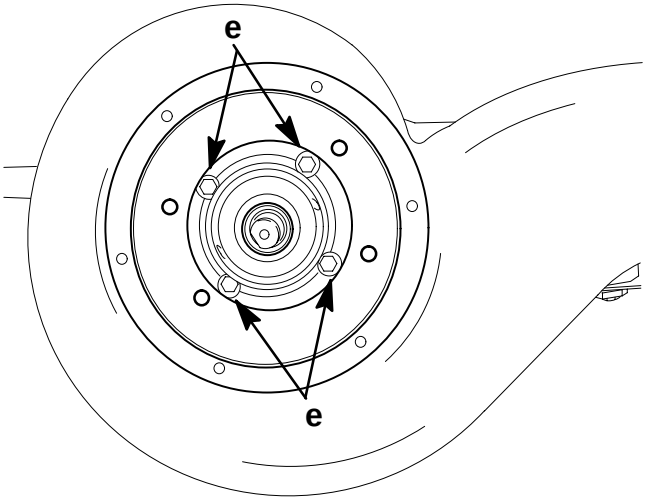
5. Grease the upper seals and inside bore of the bearing carrier to ease entry of the seal housing.
6. Install the thrust washer (d) against the ball bearing.
7. Install spacer (c), and the upper seal housing (b) being careful not to damage the O-ring seals as they pass the snap ring groove. Only finger pressure should be necessary to push in the housing.
8. Install the beveled snap ring (a), beveled side facing up into the ring groove. Make sure the snap ring is fully seated into groove.

Bearing Carrier Installation

1. Install the bearing carrier into the jet drive. Secure carrier in drive with 4 bolts. Torque bolts to 70 lb. in. (7.9 N·m).
2. Fill carrier with grease, using the grease gun supplied with the jet drive. If using a hand lever gun, pump very slowly so as to not build up internal grease pressure and damage the seals or housing.



a - Snap Ring
b - Upper Seal Housing
c - Spacer
d - Thrust Washer
e - Bolts [Torque to 70 lb. in. (7.9 N·m)]



Installing Jet Drive to Drive Shaft Housing

Reassembling Water Pump to Jet Drive

NOTE: *Replace cover if thickness of steel at discharge slots is 0.060 in. (1.524mm) or less, or if groove(s) (other than impeller sealing groove) in cover roof are more than 0.030 in. (0.762mm) deep.*

NOTE: *Replace impeller if:*

a. Impeller blades are cracked, torn or worn.

b. Impeller is glazed or melted (caused by insufficient water supply.)

c. Rubber portion of impeller is not bonded to impeller hub.

1. Install base plate, pump cover gasket (NEOPRENE STRIP FACES UP) and impeller key.

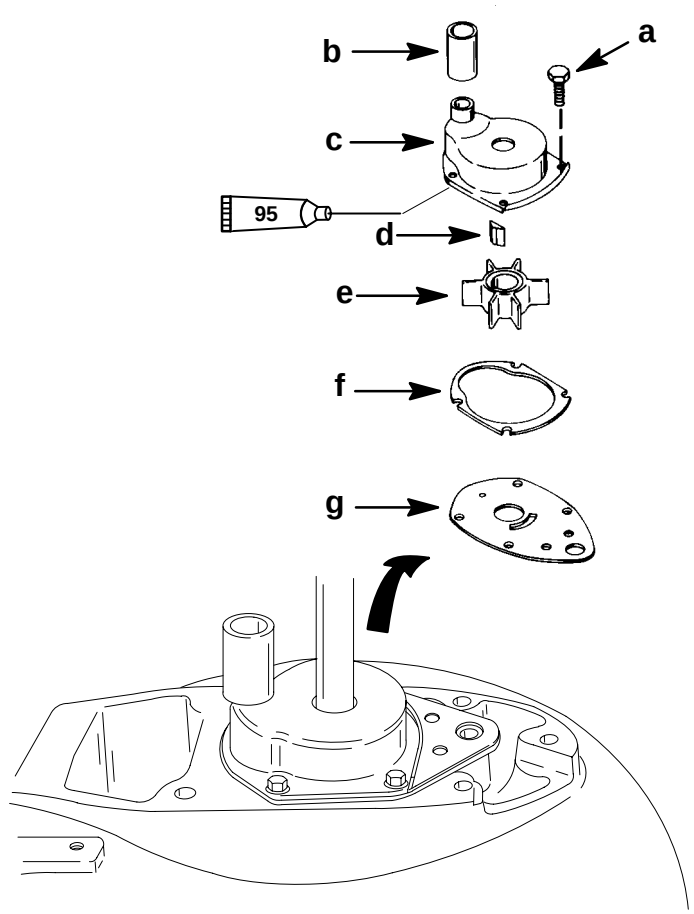
IMPORTANT: If impeller being installed has been previously used and vanes have taken a "set," DO NOT INSTALL THE IMPELLER WITH THE VANES REVERSED FROM THEIR PREVIOUS "SET" AS VANE BREAKAGE WILL OCCUR SHORTLY AFTER UNIT IS RETURNED TO SERVICE.

2. Install impeller.

NOTE: *Apply a light coat of 2-4-C w/Teflon to inside of pump cover to ease installation of cover over impeller.*

3. Install pump cover. Rotate drive shaft CLOCKWISE while pressing cover down over impeller.

4. Apply Loctite 271 to retaining bolts (4) and torque to 60 lb. in. (6.8 N·m).



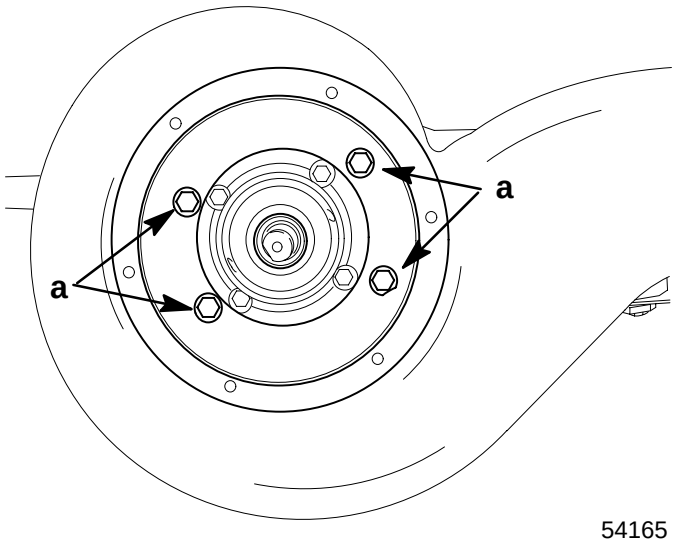
54258

95 2-4-C With Teflon (92-825407A12)

a - Bolts (4) [Apply Loctite 271. Torque to 60 lb. in. (7.0 N·m)]
b - Seal
c - Cover
d - Key
e - Impeller
f - Gasket
g - Plate

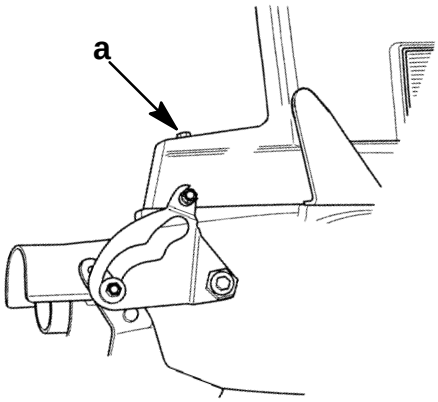
Installing Jet Drive to Drive Shaft Housing

1. Apply a light coat of 2-4-C w/Teflon to the drive shaft splines. DO NOT APPLY GREASE TO THE TOP OF THE DRIVE SHAFT AS THE GREASE WILL PREVENT THE DRIVE SHAFT FROM FULLY ENGAGING THE CRANKSHAFT AND DAMAGE TO THE POWERHEAD AND/OR GEAR CASE WILL RESULT.
2. Carefully slide jet drive into drive shaft housing while aligning drive shaft splines with crankshaft and the water tube with the water pump cover seal.
3. Secure jet drive to drive shaft housing with 4 bolts. Torque bolts to 25 lb. ft. (34.0 N·m)].



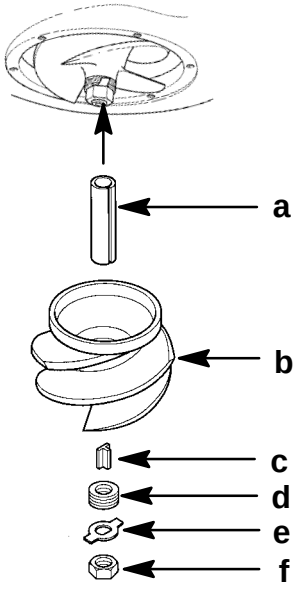
a - Bolts [Torque to 25 lb. ft. (33.9 N·m)]

4. Secure aft end of jet drive to drive shaft housing with bolt and washer. Torque bolt to 22.5 lb. ft. (30 .5 N·m).



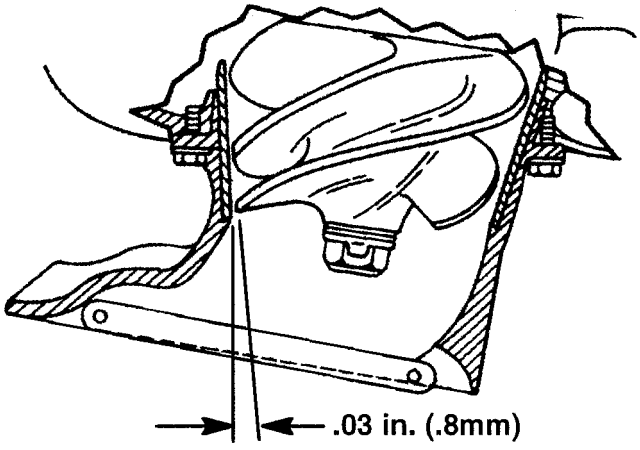
a - Bolt and Washer [Torque to 22.5 N·m)]

5. Grease the drive shaft, shear key, and impeller bore. Place the plastic sleeve (a) inside the impeller (b) and install impeller, shear key (c), shims (d) nut retainer (e), and impeller nut (f). Turn the nut tight on the shaft to remove any play between the impeller and shaft. If the tabs on the retainer do not line up with the flats on the nut, remove the nut and turn the retainer over and re-tighten the nut again.

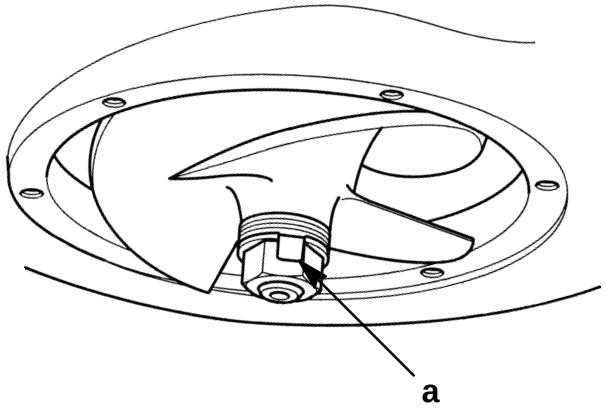


a - Plastic Sleeve
b - Impeller
c - Shear Key
d - Shims
e - Nut Retainer
f - Impeller Nut

6. Temporarily reinstall the water intake housing in order to check for impeller clearance. The clearance between the impeller and liner should be 0.030 in. (0.8 mm). Shim washers can be transferred to either side of the impeller to raise or lower the impeller to the correct clearance setting. The water intake housing can be shifted side ways a small amount in order to center the liner.



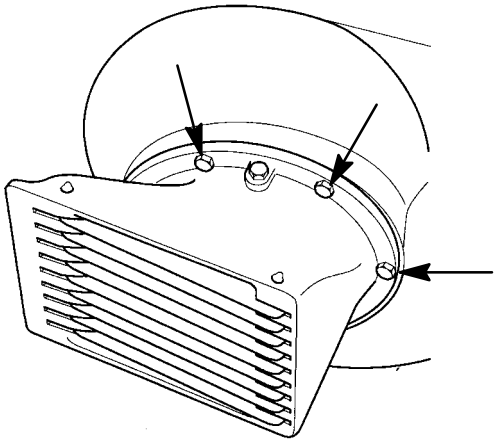
7. After setting the impeller height, tighten the impeller nut snug with a wrench. Secure impeller nut by bending tabs (a) against the flats on the impeller nut.



a - Tabs

8. Reinstall the water intake housing with six bolts. Check clearance around the impeller to make sure the water intake housing is centered and not rubbing against the liner. Torque mounting bolts to 100 lbs. in. (11.5 N·m).

NOTE: *If the outboard is used in salt water, apply Quicksilver Anti-Corrosion Grease around the entire mounting flange on the water intake housing and also to the threads on the six mounting bolts.*



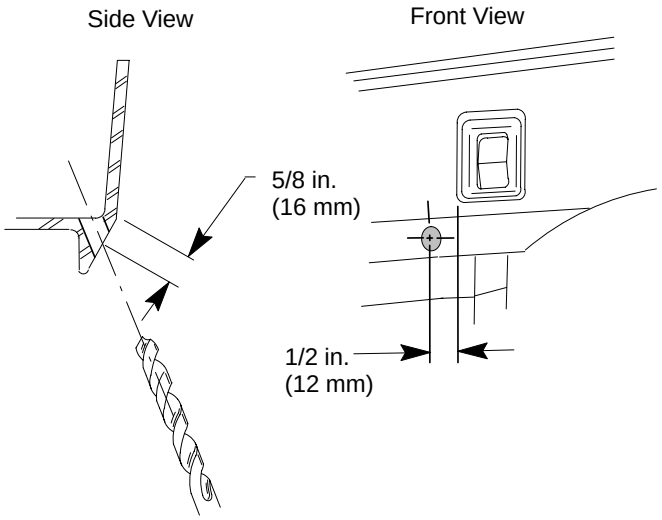
9. Refer to “SHIFT CABLE INSTALLATION” page 8 and reinstall shift cable to jet drive.

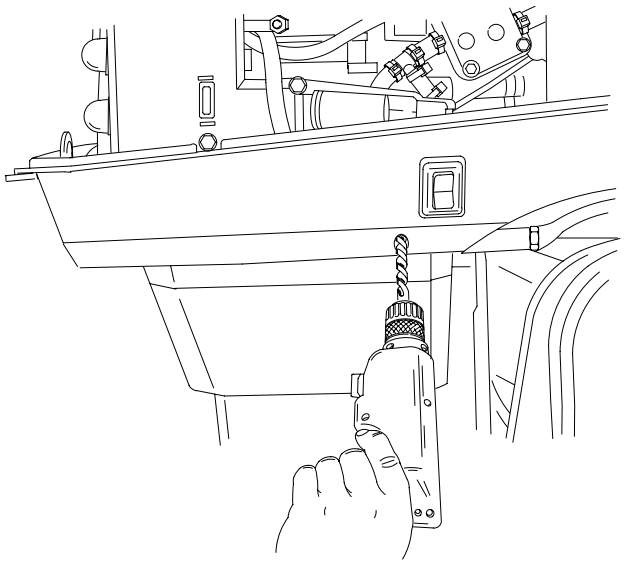
Jet Drive Tiller Handle Adaptor Kit

Installation Instructions

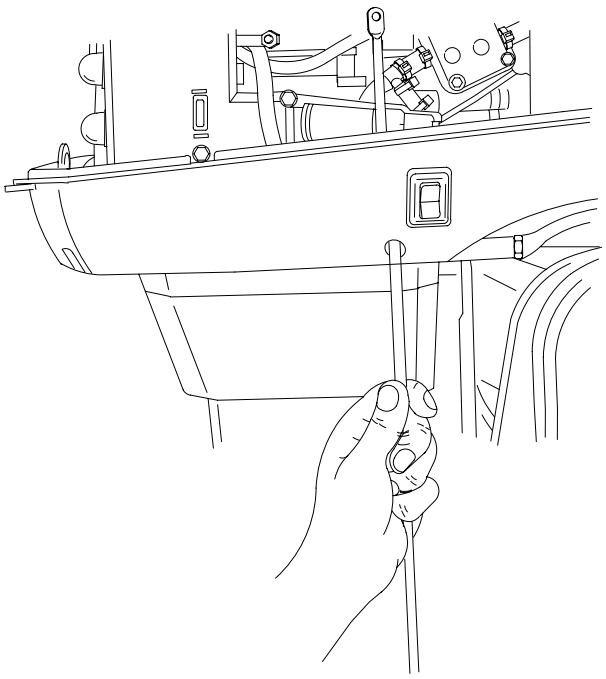
NOTE: *This kit must be used in conjunction with the recommended Quicksilver tiller handle kit.*

1. Drill hole in bottom cowl for cable routing as follows:
   a. Locate the center lines for the hole following the dimensions given in the illustration below. Use a center punch to mark center of hole.
   b. Drill a 1/4 in. pilot hole and then a 9/16 in. hole angling up into the bottom cowl.

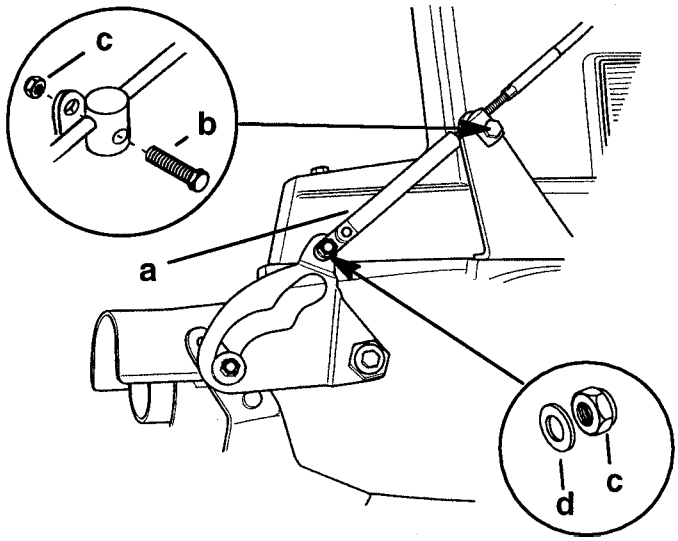




2. Check to see if the shift cable will slide through the drilled hole. If necessary, use a file to remove any extra metal from the hole.

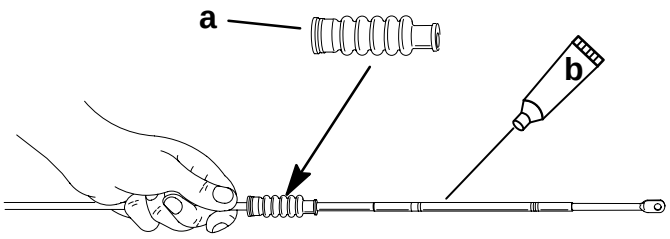


3. Install the shift cable to the jet drive. Use the existing mounting hardware supplied with the outboard. Adjust shift cable after kit is installed.



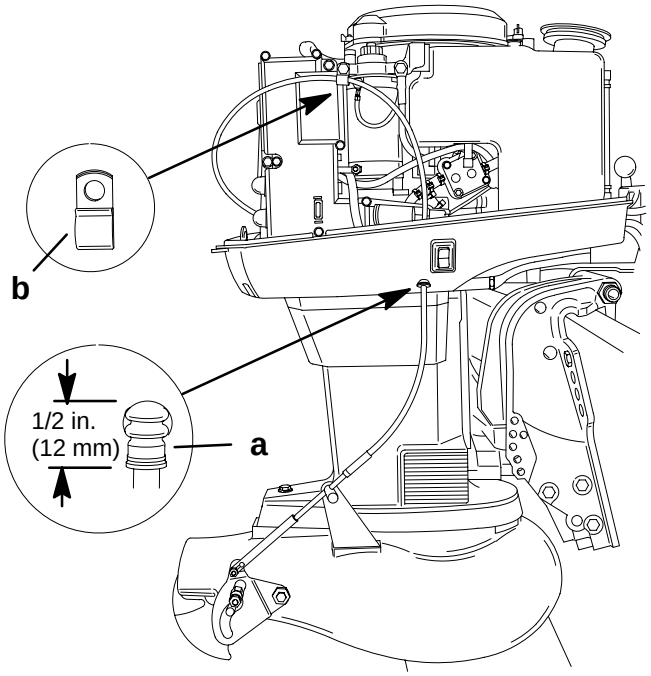
a - Shift Cable
b - Bolt
c - Locknut
d - Flat Washer

4. Lubricate the shift cable. Slide the cable boot onto the cable.



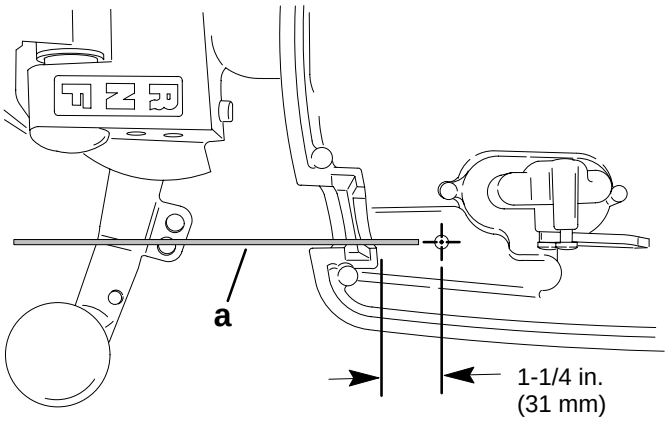
a - Cable Boot
b - Lubricant

5. Slide the shift cable through the drilled hole.
6. Position the cable boot 1/2 in. (12 mm) out of the drilled hole.
7. Fasten shift cable to the starter motor mount with J-clip.



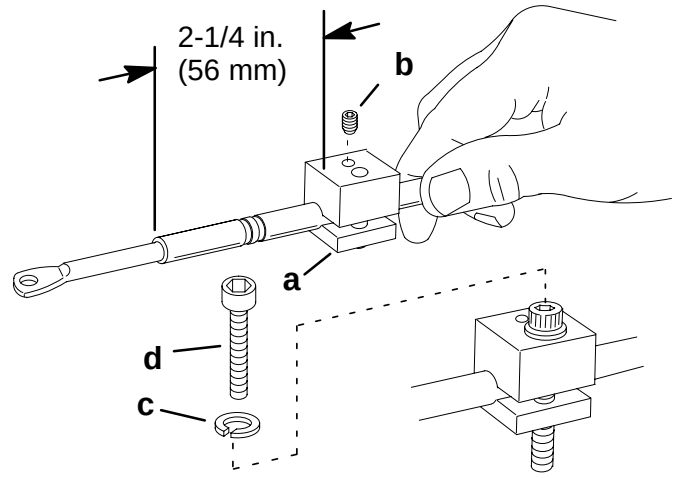
a - Position Cable Boot 1/2 in. (12 mm) out of Drilled Hole
b - J-Clip

8. Drill the shift cable retainer mounting hole as follows:
   a. Remove air box cover off the carburetors. Reinstall after installation.
   b. Lay a straight ruler above the corner radius and across the flat side of the cable opening in the bottom cowl.
   c. locate the center of hole by measuring 1-1/4 in. (31 mm) from the opening.
   d. Drill a 9/32 in. hole through bottom cowl.



a - Straight Ruler

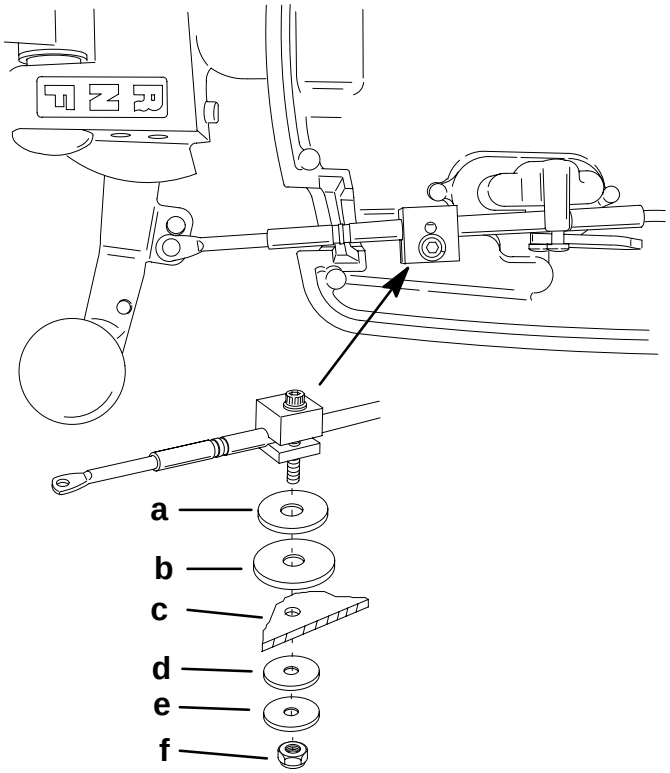
9. Rotate the shift cable retainer so that the set screw is facing up and the slot is facing out.
10. Slide shift cable into retainer until brass tube extends out 2-1/4 in. (56 mm). Secure the retainer at this position by tightening the set screw until it is snug, then add an additional 1/8 turn.
11. Install the Allen head screw and tighten securely.



a - Cable Retainer
b - Set Screw
c - Lock Washer
d - Allen Head Screw - Tighten Securely

12. Fasten the shift cable retainer to the bottom cowl with the mounting hardware shown. Tighten locknut, then back-off the locknut 1/4 turn.

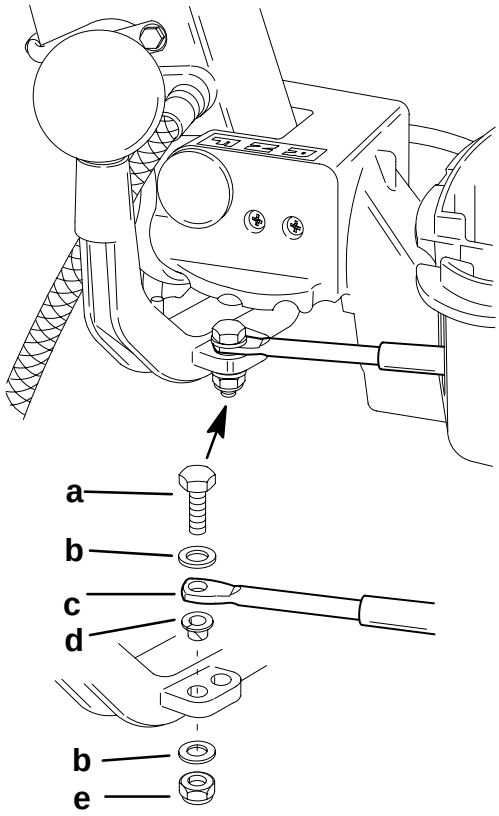
IMPORTANT: Do not over-tighten. Shift cable retainer must be free to pivot.



a - 7/8 in. OD White Nylon Washer
b - 1.00 in. OD Flat Washer
c - Bottom Cowl
d - 5/8 in. OD Black Nylon Washer
e - 21/32 in. OD Flat WAsher
f - Locknut - Tighten, Then Back-Off The Locknut 1/4 turn.

13. Attach the shift cable to the outer flange hole.

IMPORTANT: Do not over-tighten. Shift Cable must be free to pivot.

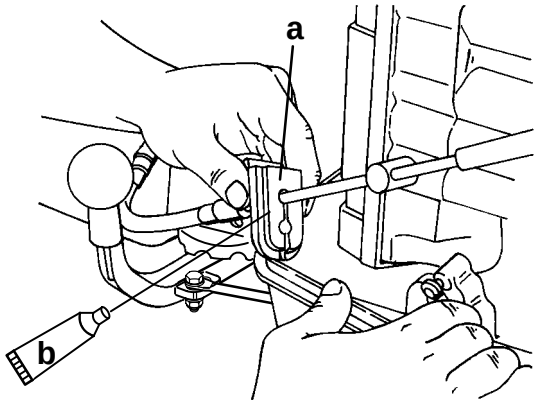


a - Bolt
b - 1/2 in. OD Flat Washer
c - Shift Cable
d - Nylon Bearing
e - Locknut - Tighten, Then Back-Off The Locknut 1/4 turn.

14. Lubricate the new cable seal.

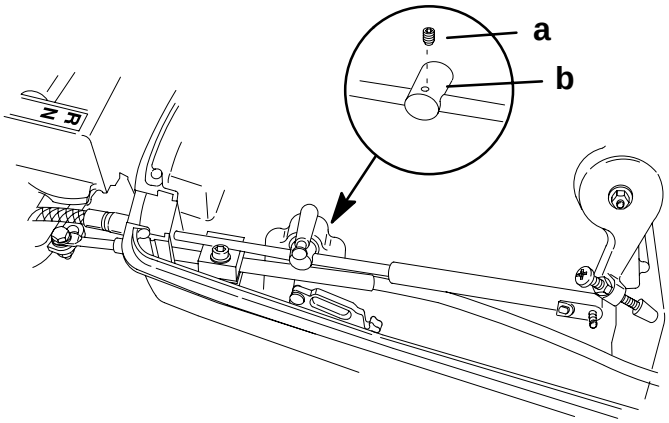
15. Slip the cable seal onto the throttle cable.

16. Place the cable seal along with the throttle cable into the cowl opening. Spread the seal over the shift cable.



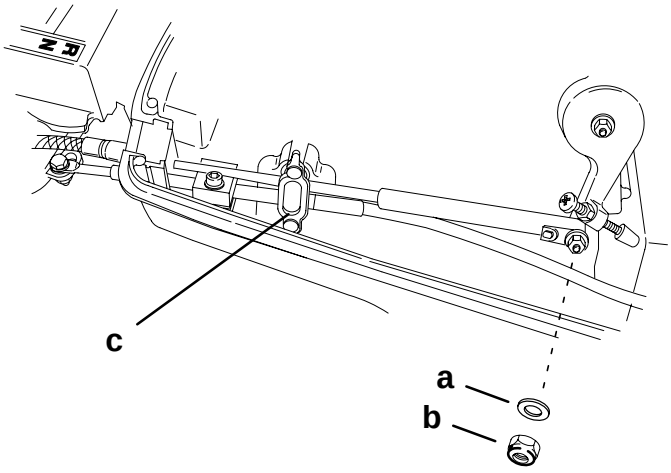
a - Cable Seal
b - Lubricant

17. Install the throttle cable as follows:
    a. Rotate the throttle grip to the IDLE position.
    b. loosen the set screw (a) in the cable barrel.
    c. Position the throttle cable barrel (b) so the barrel will be able to slip into the retainer when the cable end is on the mounting stud and there is a slight pre-load against the throttle stop.
    d. Apply a small amount of Loctite to threads on set screw and tighten until snug, then add an additional 1/8 turn.



a - Set Screw
b - Cable Barrel

18. Place the cable barrel into retainer.
19. Fasten the cable end to mounting stud with nylon washer (a) and locknut (b). Tighten locknut against the nylon washer, then back-off the locknut 1/4 turn.
20. Secure the retainer in place with cable latch (c).



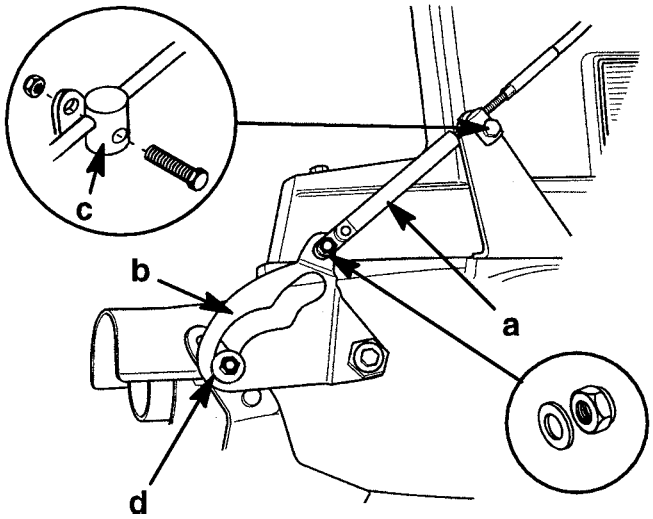
a - Nylon Washer
b - Locknut - Tighten Locknut Against The Nylon Washer, Then Back-Off The Locknut 1/4 turn.
c - Cable Latch

Shift Cable Adjustment

⚠ WARNING

The shift cable must be adjusted to lock the reverse gate against unexpected engagement (caused by water pressure hitting the gate) while operating the boat in forward. Activation of the reverse gate will cause sudden unexpected stopping of the boat. Sudden stopping may cause occupants to be thrown within the boat or even out of the boat. This action may result in serious injury or death.

1. Place shift lever into full forward position.
2. Adjust the brass barrel (c) on the shift cable so that roller (d) is at the full end of travel (bottom) in the shift cam when the shift lever is in forward.
3. Attach the brass barrel (c) to the bracket with bolt and locknut. Tighten the bolt until it seats against the barrel, then back-off the bolt 1/4 turn. Hold bolt from turning, and tighten locknut on bolt. The barrel must be free to pivot.

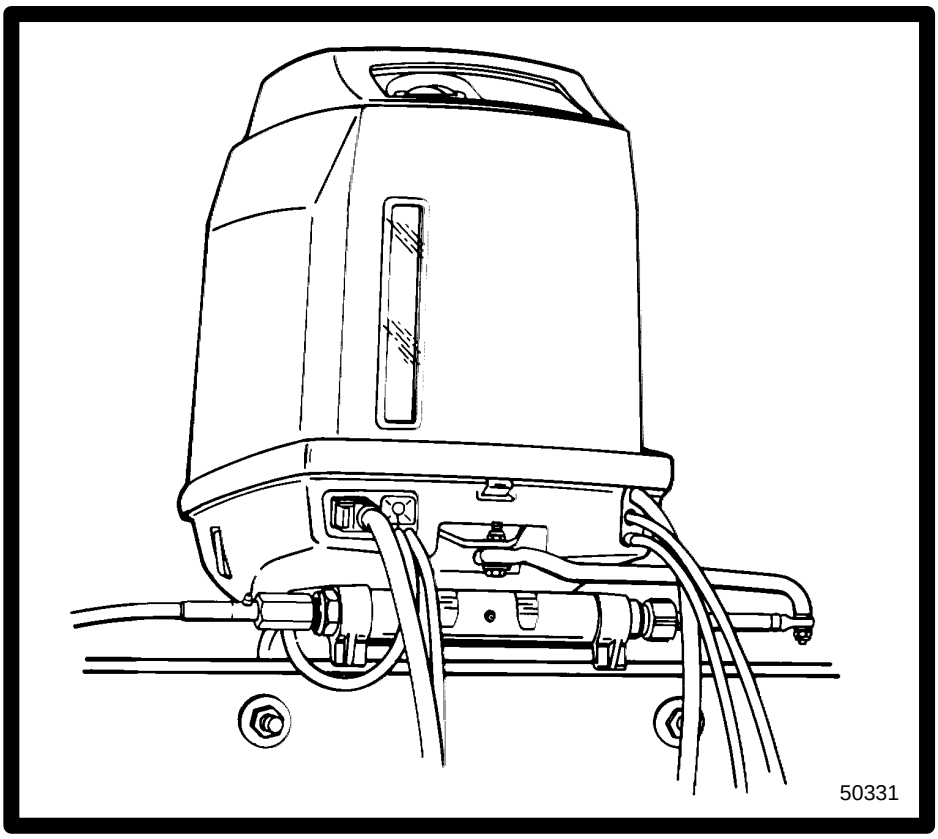


a - Shift Cable
b - Shift Cam
c - Barrel
d - Roller

4. Recheck the shift cable adjustment in forward shift position. The correct shift adjustment will position the cam far enough on the roller in order to lock the the reverse gate into forward position. You should not be able to forcibly push up the reverse gate toward neutral. Pull on the reverse gate by hand to verify this.

IMPORTANT: The forward locking of the reverse gate must be met. If not, readjust the shift cable.

OUTBOARD INSTALLATION/ ATTACHMENTS



RIDE-GUIDE STEERING - THROTTLE/SHIFT CABLES & ELECTRICAL CONNECTIONS

7

A

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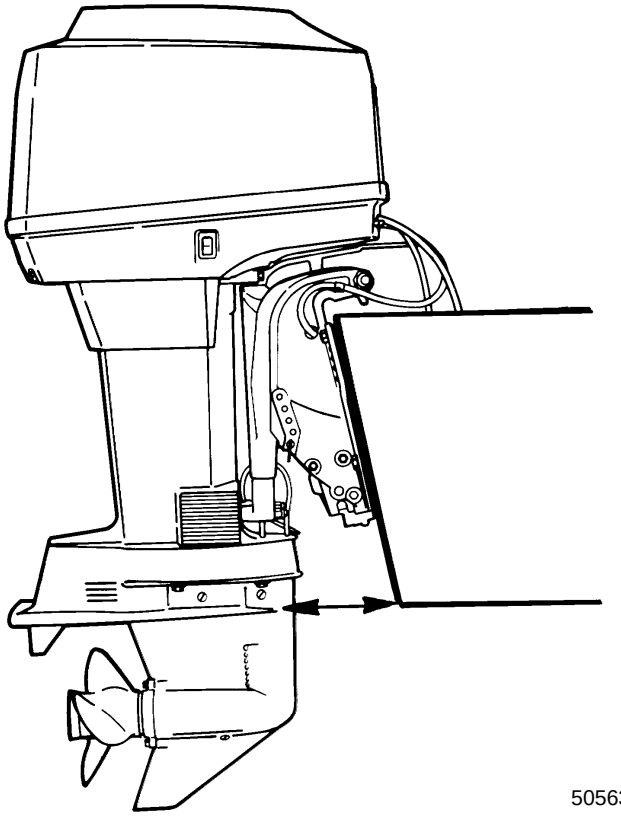
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Installing Outboard Motor on Transom

Determining Recommended Outboard Mounting Height

It is recommended for best-all-around boating performance, the outboard should be mounted with the anti-ventilation plate parallel to and at the same level as the boat bottom.

On boats with a 20 in. (508mm) transom height, this will require that the outboard be mounted approximately 1 in. (25.4mm) high on the transom as the outboard has a 21 in. (533mm) shaft length.



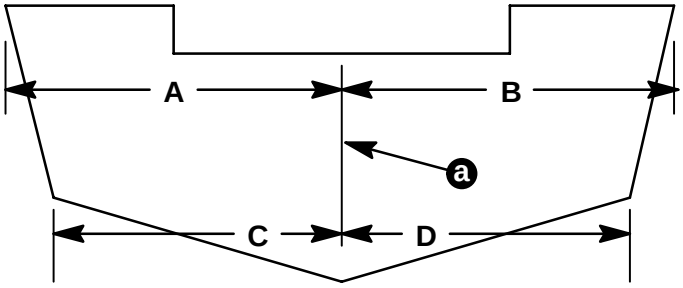
50563

If, with the outboard mounted so that the anti-ventilation plate is level with the bottom of the boat, excessive propeller slippage/cavitation is experienced, it is recommended that the outboard be lowered one position on the transom to increase propeller “BITE” at a slight loss at top end speed and increase spray.

NOTE: *Raising or lowering the outboard by one mounting hole will change outboard height by approximately 3/4 in. (19mm).*

Locate Centerline of Boat Transom

Locate (and mark with a pencil) vertical centerline (a) of boat transom, as shown.



NOTE: *Dimension “A” & “B” and “C” & “D” are Equal Length.*

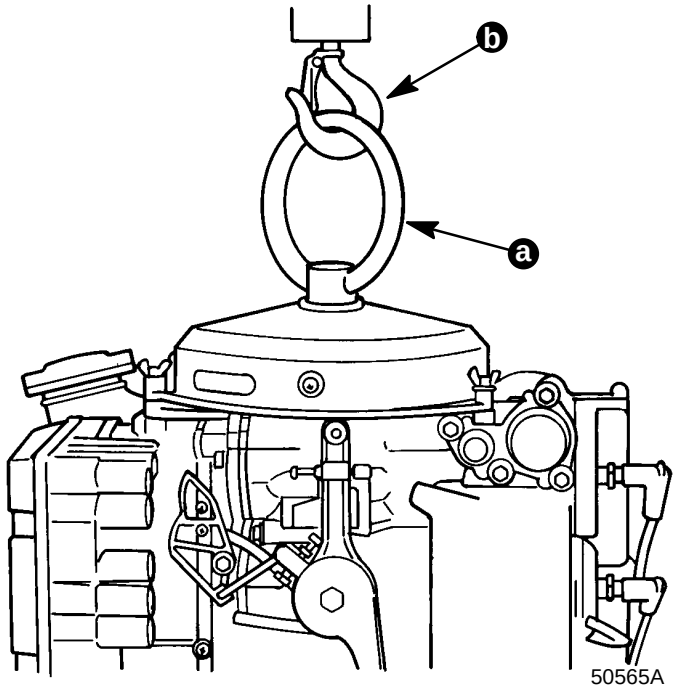
Lifting Outboard (Electric Start Models)

⚠ WARNING

Make sure that lifting eye is threaded into flywheel a minimum of 5 turns and that hoist has a minimum lift capacity of at least 500 lbs. (227 kg) BEFORE lifting outboard.

Remove cowling from outboard and plastic cap from center of flywheel. Thread lifting eye (a) into flywheel hub a minimum of 5 turns. Replace plastic cap after installation.

Connect hoist [minimum lift capacity of 500 lbs. (227 kg)] to lifting eye or rings of lift harness and lift outboard onto boat transom.

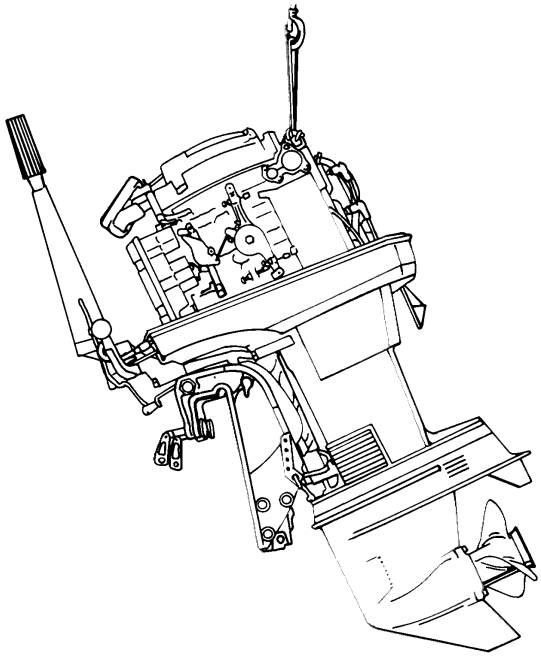


50565A

a - Lifting Ring (P/N 91-75132)
b - Hoist

Lifting Outboard (Manual Start Models)

Remove cowling from outboard. Use lifting eye on outboard and lift outboard on boat transom.



51456

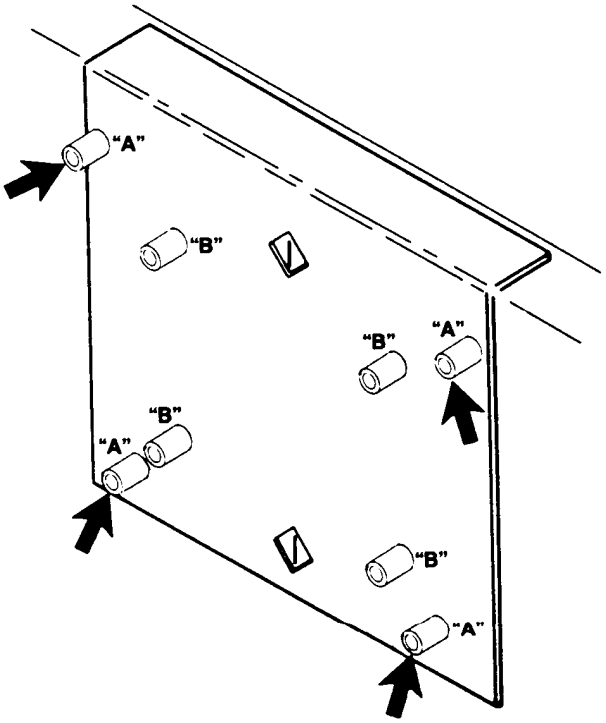
Drilling Outboard Mounting Holes (Electric Start Models)

IMPORTANT: Before drilling any mounting holes, carefully read "Determining Recommended Outboard Motor Mounting Height", preceding. There is a 3/4 in. (19mm) difference between outboard mounting holes in transom bracket.

⚠ WARNING

DO NOT under any circumstances, allow upper outboard mounting bolts to be closer than 1 in. (25.4mm) from top of boat transom. Upper mounting bolts must never be installed thru shims.

IMPORTANT: If using "Transom Drill Fixture" (91-98234A2), use drill guide holes marked "A" when drilling outboard mounting holes.

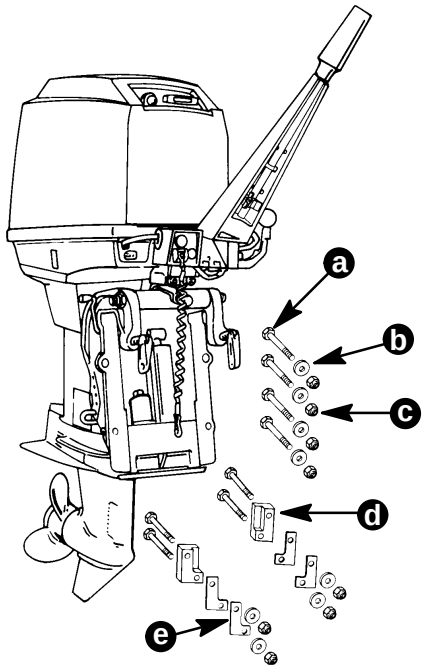


1. Secure (tape) "Outboard Mounting Template" (located in center of Installation Manual) to outside of boat transom.
2. Align "Top of Boat Transom Line" of template with top edge of (real) boat transom, not shim(s).
3. Align vertical centerline of template with centerline of transom.
4. Use a 17/32 in. (13.5mm) diameter drill bit and drill 4 mounting holes perpendicular to and thru transom at marked hole centers on template.

Fastening Outboard on Boat Transom (Manual Start Models)

⚠ WARNING

Outboard must be fastened to boat transom with transom clamp handles and transom clamp retainers or mounting bolts as shown in installation A or B should the outboard strike an underwater object or be steered into a sharp turn. Failure to tighten transom clamp handles along with installing transom clamp retainers or mounting bolts could result in outboard ejecting suddenly off boat transom causing serious injury or death, boat damage or loss of outboard.



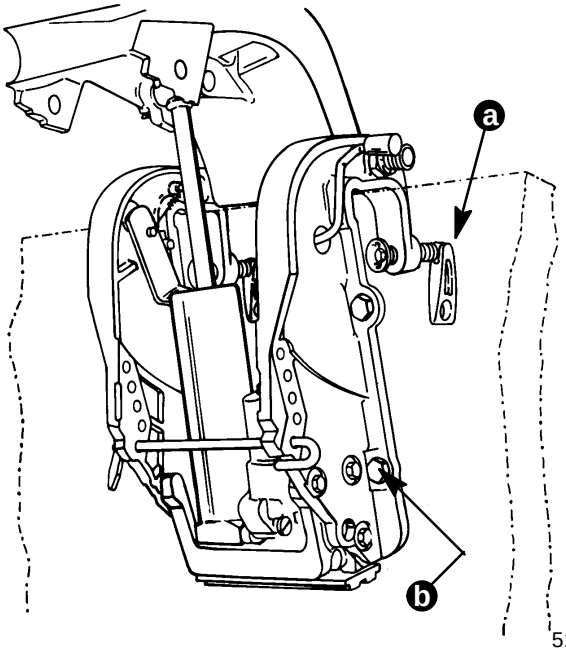
51509

a - Mounting Bolts (4)
b - Flat Washers (4)
c - Locknuts (4)
d - Transom Clamp Retainers With Mounting Hardware
e - Shims - Transom Clamp Retainers (If Required)

Fasten outboard to boat transom following installation A or B shown below.

Installation A

Use for permanent installation.

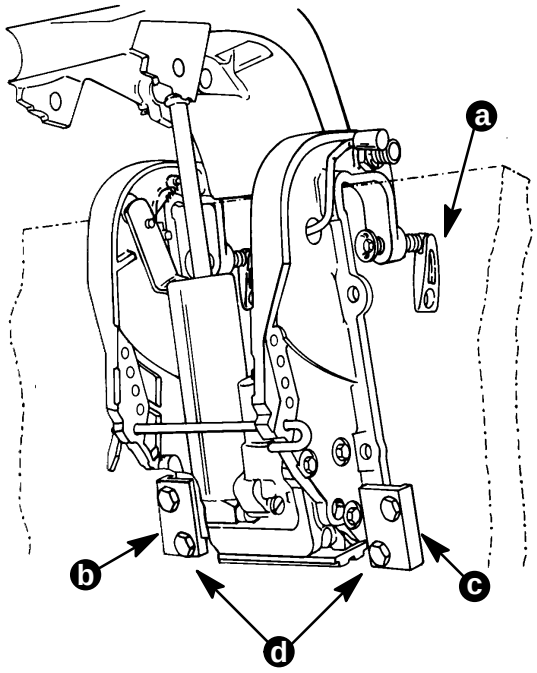


51462

a - Tighten Transom Clamp Handles
b - Mounting Bolts (Supplied with Outboard

Installation B

Use for easy removal and installation of outboard.



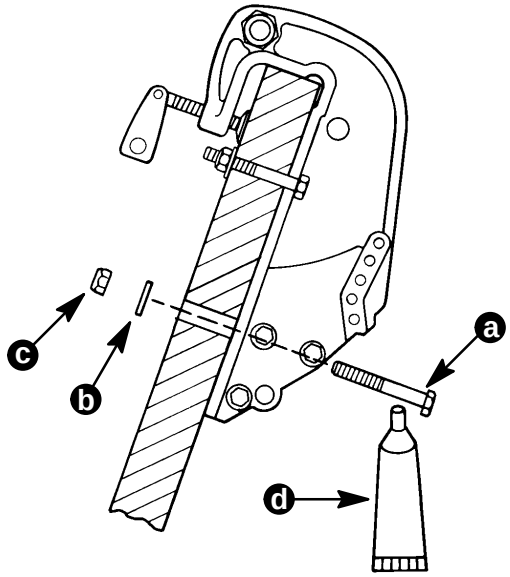
51462

a - Tighten Transom Clamp Handels
b - Part Number 812433-C1
c - Part Number 812432-C1
d - Transom Clamp Retainers (Opitional)

Installation A

Fastening outboard for permanent installation.

Drill four 1/2 in. (12.5mm) holes and fasten outboard to boat transom.



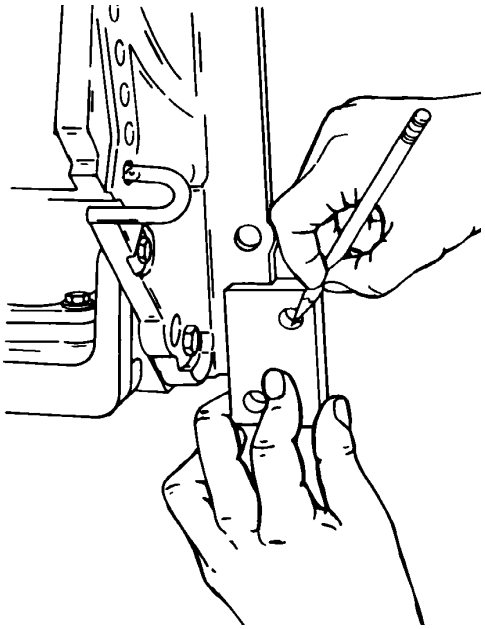
51489

a - Bolts (4)
b - Flat Washers (4)
c - Locknuts (4)
d - Marine Sealer

Installation B

Fastening outboard for easy removal and installation.

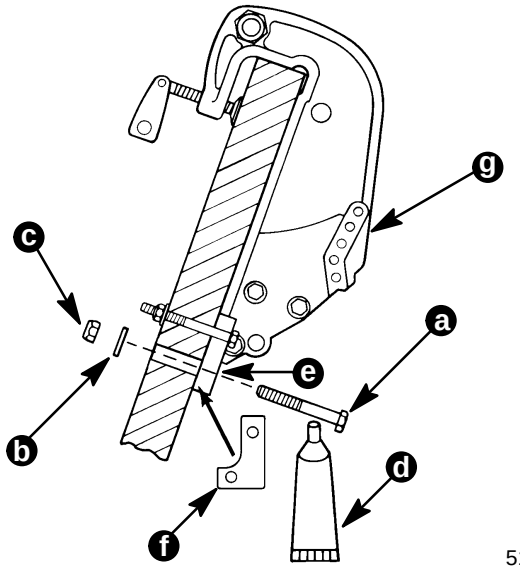
Mark hole location.



51393

Drill four 3/8 in. (9.5mm) holes and fasten transom clamp retainers to transom.

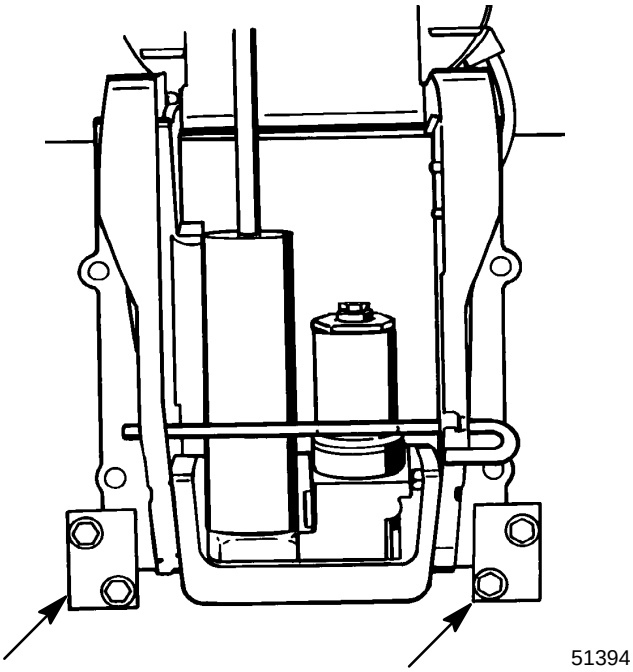
Add shims (if necessary) to allow for a small amount of clearance between transom clamps and retainers.



51489

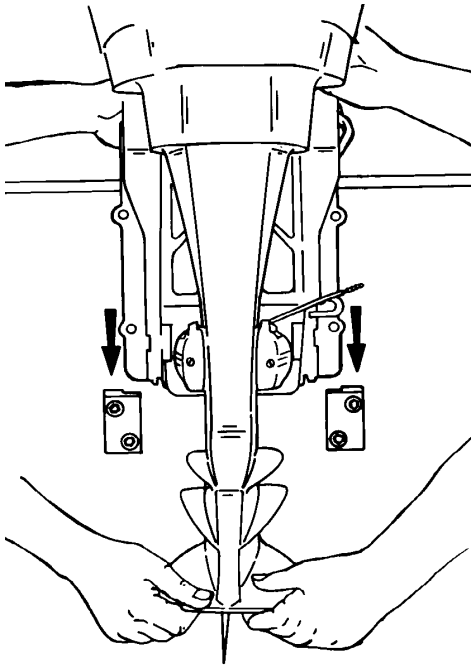
a - Bolts (4)
b - Flat Washers (4)
c - Locknuts (4)
d - Marine Sealer
e - Transom Clamp Retainers (2)
f - Shims (4)
g - Transom Clamp

Retainers installed.



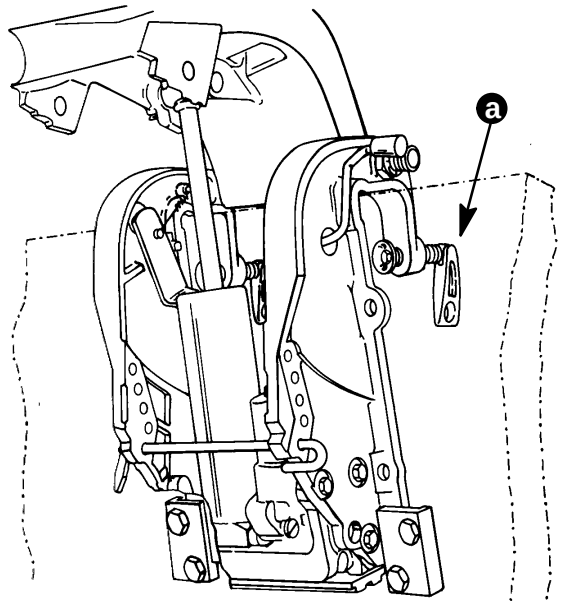
51394

Outboard can be easily removed and installed.



51395

Outboard installed.



51462

a - Tighten transom clamp, handles. Retighten every 1/2 hour.

Securing Outboard to Boat Transom (Electric Start Models)

IMPORTANT: If boat is equipped with thru tilt tube steering, steering cable end must be installed into tilt tube of outboard before securing outboard to transom. Refer to "Steering Cable and Steering Link Rod Installation", following.

Refer to "Determining Recommended Outboard Motor Mounting Height", and position outboard on boat transom aligning mounting holes in transom bracket.

⚠ CAUTION

Marine sealer must be used on shanks of mounting bolts to make a water-tight installation.

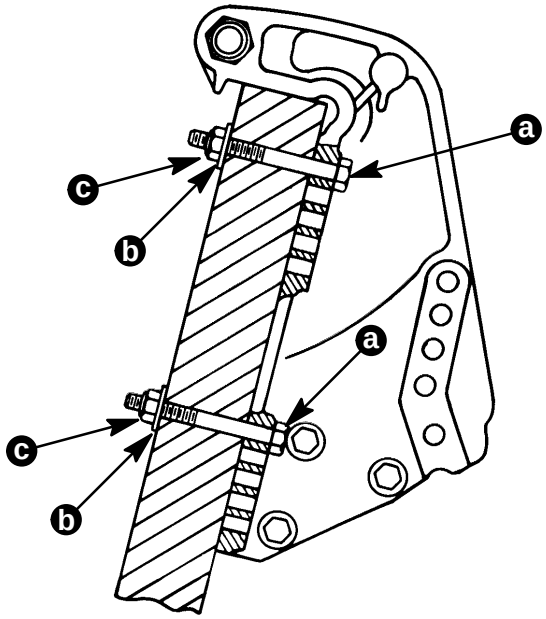
IMPORTANT: In order to avoid transom damage DO NOT use an impact driver when tightening transom mounting bolts.

Apply marine sealer to shanks of mounting bolts (not threads) secure outboard to transom with 4 bolts, flat washers and locknuts, as shown. Be sure that installation is water-tight.

⚠ WARNING

Before operating, outboards(s) MUST BE SECURED to boat transom with four 1/2 in. diameter bolts and locknuts, as follows: 2 bolts must be installed thru upper mounting holes and 2 bolts thru lower mounting holes.

Installation must be water-tight, and outboard should be checked for tightness on the transom during operation. Failure to bolt outboard to transom (using 4 bolts and locknuts, as shown) may result in damage to boat and/or loss of outboard and possible injury to occupants of boat.



50181

a - Mounting Bolt 4 in. Long (4 Req'd)
b - Flat Washer (4 Req'd)
c - Locknut (4 Req'd)

Steering Cable Installation

Refer to "Quicksilver Accessories Guide" to determine correct length of steering cable and remote control cables.

IMPORTANT: Steering cable and remote control cables must be the correct length. Cables which are too short or too long will result in unwanted cable stress.

Install steering mount and steering wheel in accordance with installation instructions that accompany each.

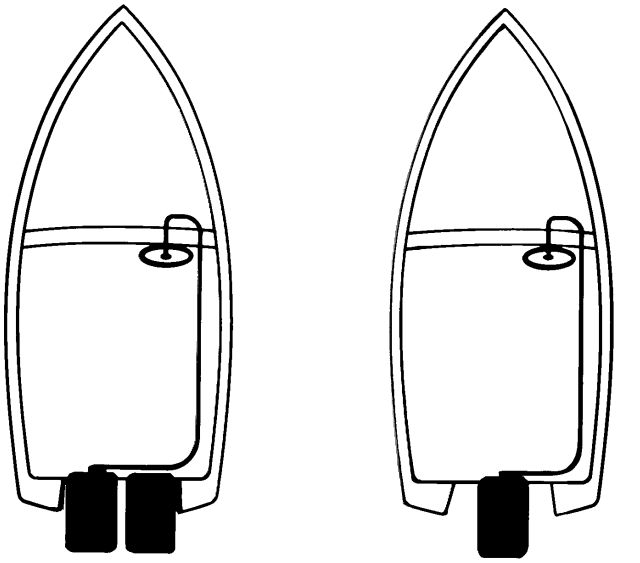
Dual Outboard

IMPORTANT: The distance from each outboard's centerline to the side of transom opening or gunnel MUST BE a minimum of 16 in. (406mm).

With a dual steering system installation, a minimum outboard centerline distance of 21 in. (533mm) must be attained to assure interference-free movement.

Ride-Guide steering cable can be routed on either side of boat. If steering cable is routed on starboard side of boat, cable attaches to port outboard. If steering cable is routed on port side of boat, cable attaches to starboard outboard.

Cable Installation to Tilt Tube - Cable Routed on Starboard Side of Boat



51130

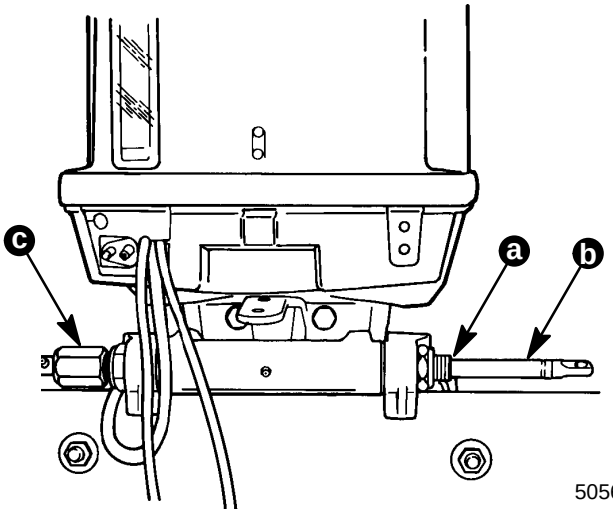
Single Cable-Dual Outboard

Single Cable-Single Outboard

IMPORTANT: Before installing steering cable tilt tube, lubricate entire cable end with Quicksilver 2-4-C Marine Lubricant.

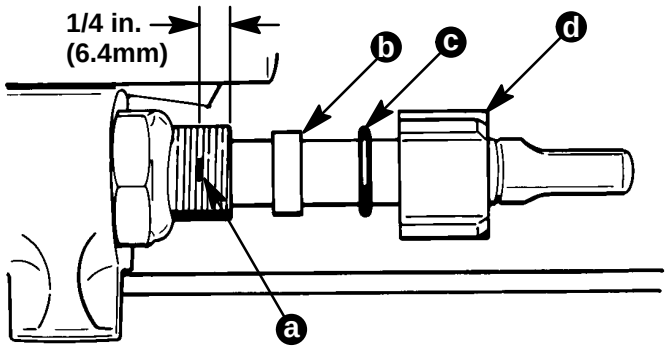
NOTE: *Ride-Guide Steering cable is lubricated at the factory and requires no additional lubrication at initial installation.*

1. Lubricate inside of outboard tilt tube (a) and steering cable end (b) with Quicksilver 2-4-C Marine Lubricant.
2. Insert steering cable end thru outboard tilt tube and secure with steering cable attaching nut (c). Torque to 35 lb. ft. (41 N·m).



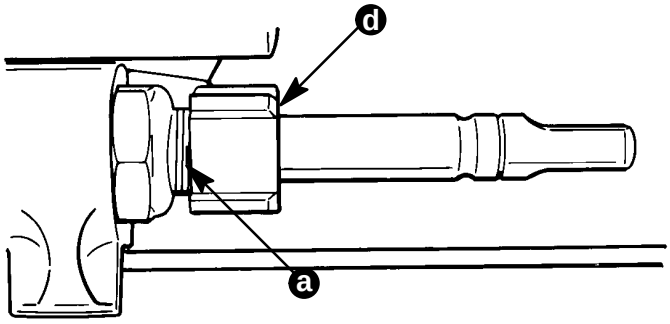
50564B

3. Make pencil mark (a) on tilt tube 1/4 in. (6.4mm) from port end of tube. Slide spacer (b), O-ring (c) and cap (d) over steering cable end.



50180

4. Thread cap (d) onto tilt tube, up to mark (a).



50180

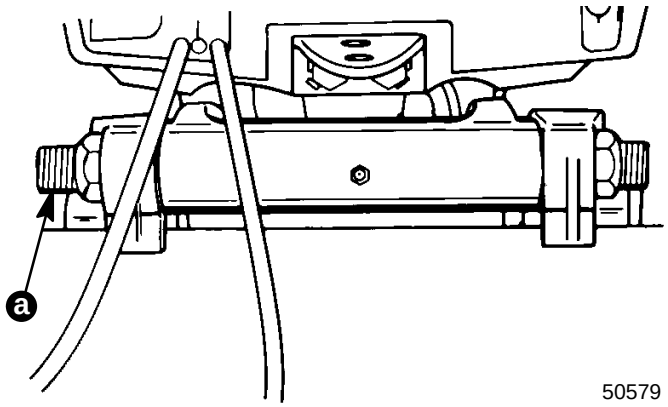
Cable Installation to Tilt Tube - Cable Routed on Port Side of Boat

TILT TUBE REVERSAL

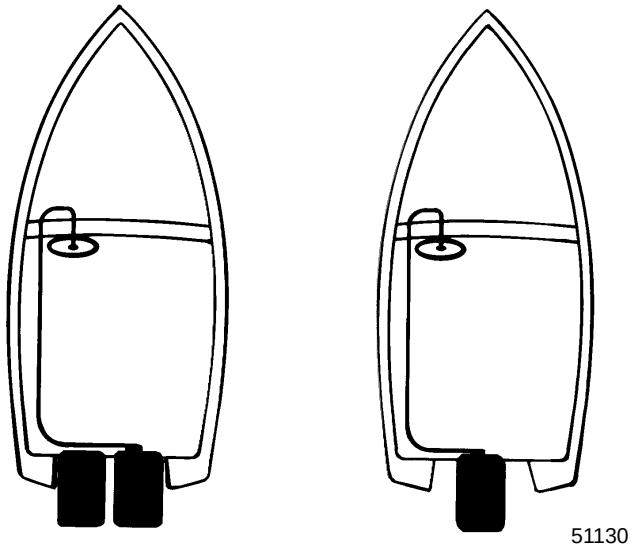
⚠ CAUTION

Outboard tilt tube MUST BE removed and re-installed in the opposite direction. When re-assembled, longer threaded end of tilt tube extends out port side of outboard approximately 3/4 in. (19mm). Failure to reposition outboard tilt tube as described could interfere with steering system operation.

Remove outboard tilt tube and re-install in the opposite direction (turn end for end). When re-assembled, longer threaded end (a) of tilt tube extends out port side of outboard approximately 3/4 in. (19mm). Refer to Section 5A “Midsection”.



50579



51130

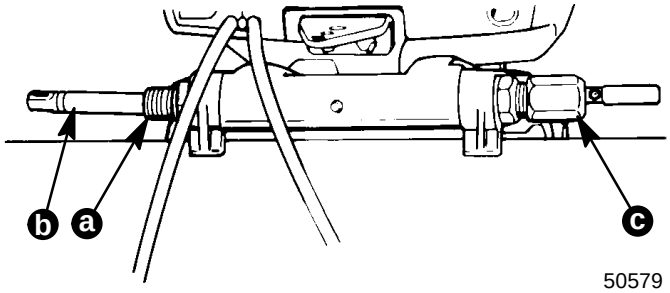
Single Cable-Dual Outboard

Single Cable-Single Outboard

IMPORTANT: Before installing steering cable tilt tube, lubricate entire cable end with Quicksilver 2-4-C w/Teflon Marine Lubricant.

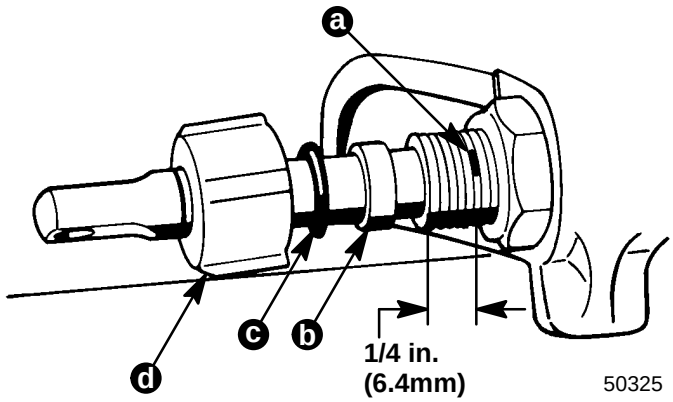
NOTE: *Ride-Guide Steering cable is lubricated at the factory and requires no additional lubrication at initial installation.*

1. Lubricate inside of outboard tilt tube (a) and steering cable end (b) with Quicksilver 2-4-C w/Teflon Marine Lubricant.
2. Insert steering cable end thru outboard tilt tube and secure with steering cable attaching nut (c). Torque to 35 lb. ft. (41 N·m).



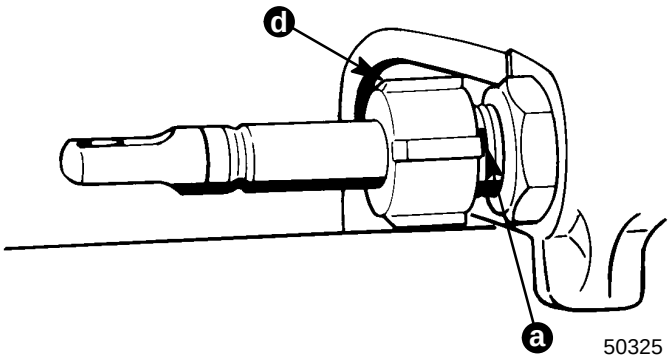
50579

3. Make pencil mark (a) on tilt tube 1/4 in. (6.4mm) from starboard end of tube. Slide spacer (b), O-ring (c) and cap (d) over steering cable end.



50325

4. Thread cap (d) onto tilt tube, up to mark (a).



50325

Installing Steering Link Rod

⚠ WARNING

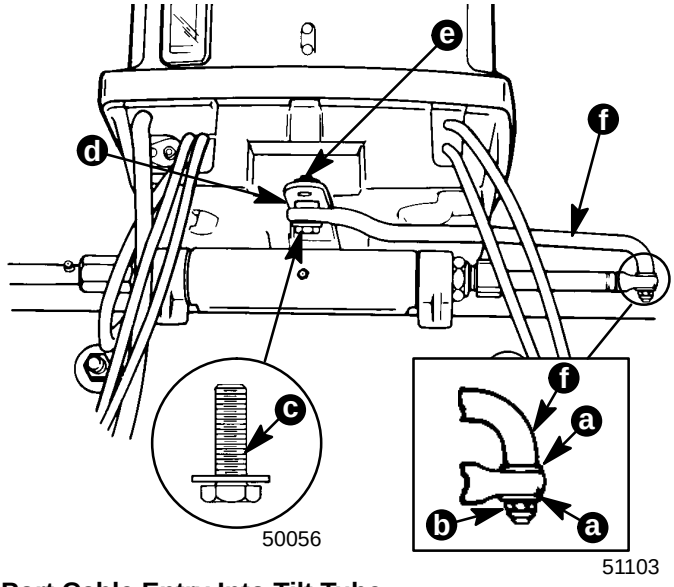
Steering link rod MUST BE secured between outboard steering arm/bracket and steering cable end using a special washer head bolt, spacer and nylon locknuts as shown. Both special washer head bolt and locknuts MUST BE tightened as specified.

Lubricate hole in end of cable with Quicksilver 2-4-C w/Teflon Marine Lubricant. Assemble steering link rod to steering cable end using 2 flat washers and nylon insert locknut. Tighten locknut until it seats [DO NOT exceed 120 lb. in. (13.5 N·m) of torque], then back off 1/4 turn.

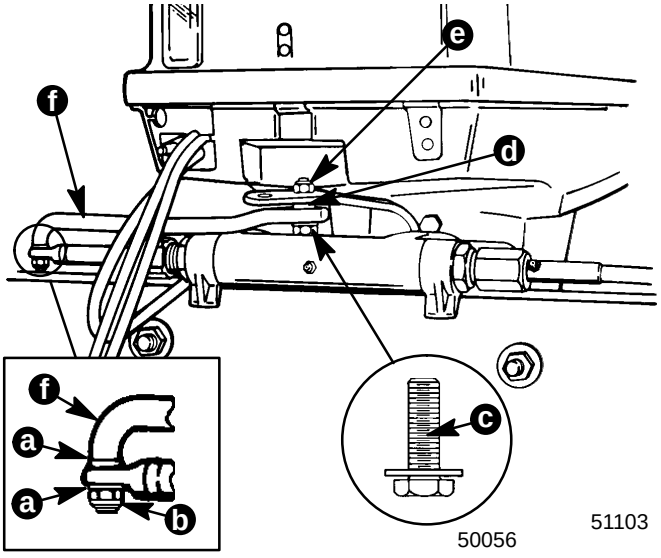
Lubricate ball joint in steering link rod with SAE 30W motor oil. Secure link rod to outboard steering arm (inner hole) using special washer head bolt and nylon insert locknut as shown. Torque bolt to 20 lb. ft. (27 N·m), then torque nut to 20 lb. ft. (27 N·m).

MODELS WITH ONE-PIECE STEERING ARM

Starboard Cable Entry Into Tilt Tube



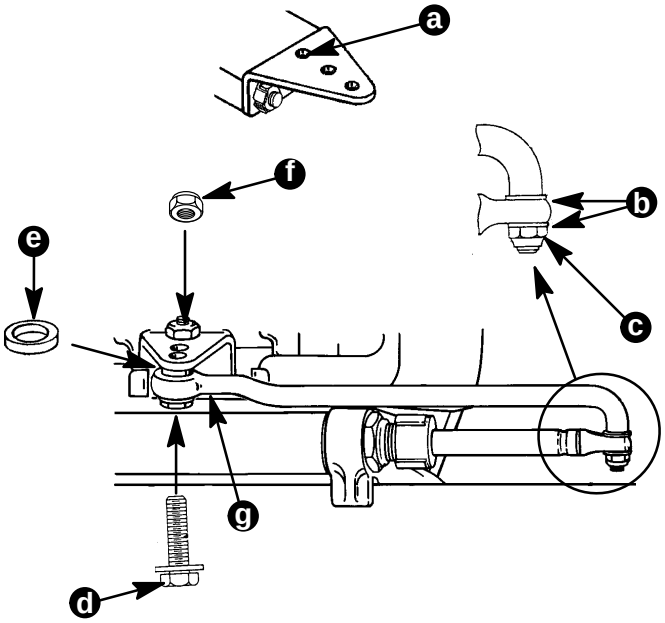
Port Cable Entry Into Tilt Tube



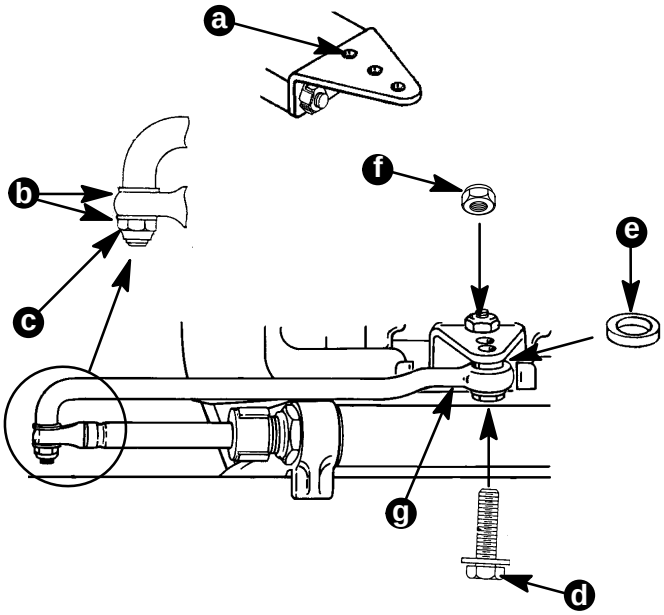
a - Flat Washer (2)
b - Nylon Insert Locknut - Torque until it seats [DO NOT Exceed 120 lb. in. (13.5 N·m) or Torque], Then back off 1/4 Turn
c - Special Washer Head Bolt, Torque to 20 lb. ft. (27 N·m)
d - Spacer
e - Nylon Insert Locknut, Torque to 20 lb. ft. (27 N·m)
f - Steering Link Rod

MODELS WITH TWO-PIECE STEERING ARM/BRACKET

Starboard Cable Entry Into Tilt Tube



Port Cable Entry Into Tilt Tube



a - Two-Piece Steering Bracket, Mount Steering Link Rod in Back Hole
b - Flat Washer (2)
c - Nylon Insert Locknut - Torque until it seats [DO NOT Exceed 120 lb. in. (14 N·m) or Torque], Then back off 1/4 Turn
d - Special Washer Head Bolt, Torque to 20 lb. ft. (27 N·m)
e - Spacer
f - Nylon Insert Locknut, Torque to 20 lb. ft. (27 N·m)
g - Steering Link Rod

⚠ WARNING

After installation is complete and before operating outboard, check that boat will turn right when steering wheel is turned right and that boat will turn left when steering wheel is turned left. Check steering thru full range (right and left) at all tilt angles to assure interference-free movement.

Maintenance Instructions

Maintenance is the owner's responsibility and must be performed at intervals specified.

Normal Service - Every 50 hours of operation or 60 days (whichever comes first).

***Severe Service -** Every 25 hours of operation or 30 days (whichever comes first).

*Operation in salt water is considered "Severe Service".

1. Carefully check steering system components for wear. Replace worn parts.
2. Check steering system fasteners to be sure that they are torqued to correct specifications.

***NOTE:** Ride-Guide Steering cable is lubricated at the factory and requires no additional lubrication at initial installation.*

⚠ WARNING

Core of steering cable (transom end) must be fully retracted into cable housing before lubricating cable. If cable is lubricated while extended, hydraulic lock of cable could occur.

3. With core of Ride-Guide Steering cable (transom end) fully retracted, lubricate transom end of steering cable thru grease fitting and exposed portion of cable end with 2-4-C Marine Lubricant. Lubricate all pivot points with SAE 30W engine oil.

Dual Steering Installation

Steering Coupler Assembly

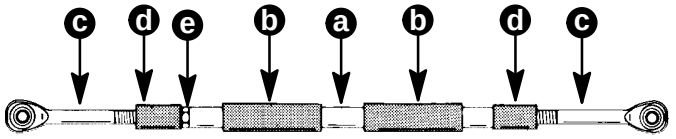
Position outboards so that they are pointing straight ahead. (Distance between threaded hole centers of steering arm/brackets MUST BE equal to distance between propeller shaft centerlines.)

Lubricate inside of rubber sleeves with 2-4-C w/Teflon Marine Lubricant and slide sleeves on steering coupler.

Work rubber bushings onto threaded ends of steering eyes.

Thread jam nut on starboard steering eye.

Thread steering eyes equally into coupler, so that distance between hole centers of steering eye ball joints is equal to distance between threaded hole centers of steering arms/brackets. Exposed threads of steering eyes MUST BE of equal length and threads MUST NOT extend out from coupler more than 2-3/4 in. (70mm).



a - Coupler
b - Rubber Sleeve
c - Steering Eye
d - Rubber Bushing
e - Jam Nut

⚠ WARNING

Both steering eyes must be threaded into coupler 3/4 in. (19mm) minimum. Thread length of steering eye is 3-1/2 in. (89mm), so exposed thread must not extend out of coupler more than 2-3/4 in. (70mm). Failure to adhere to this requirement could result in steering system failure.

Assemble steering coupler between outboard steering arms/brackets, as shown on the following pages.

IMPORTANT: With assembled steering coupler installed and before tightening special washer head bolts/locknuts, check outboard alignment. Distance between hole centers of steering eye ball joints MUST BE equal to distance between propeller shaft center lines, for proper steering. If adjustment is necessary, temporarily remove special washer head bolt/locknut from one steering eye and turn eye in or out to correct alignment.

⚠ WARNING

Both steering eyes MUST BE threaded into coupler 3/4 in. (19mm) minimum, and jam nut must be tightened against coupler to prevent coupler from turning. Torque "jam" nut to 20 lb. ft. (27 N·m).

Tighten "jam" nut against coupler. Torque "jam" nut to 20 lb. ft. (27 N·m).

Spray Quicksilver Corrosion Guard on exposed threads of steering eyes and position rubber bushings and rubber sleeves to cover exposed threads of steering eyes.

⚠ WARNING

After installation is complete (and before operating outboard(s), check that boat will turn right when steering wheel is turned right and that boat will turn left when steering wheel is turned left. Check steering thru full range (left and right) at all tilt angles to assure interference-free movement.

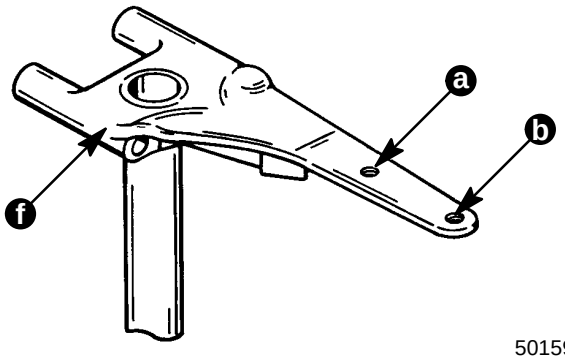
Adjust trim tabs of both outboards, as outlined in "Trim Tab Adjustment", following.

Installation

IMPORTANT: Lubricate all moving parts with Quicksilver 2-4-C w/Teflon Marine Lubricant.

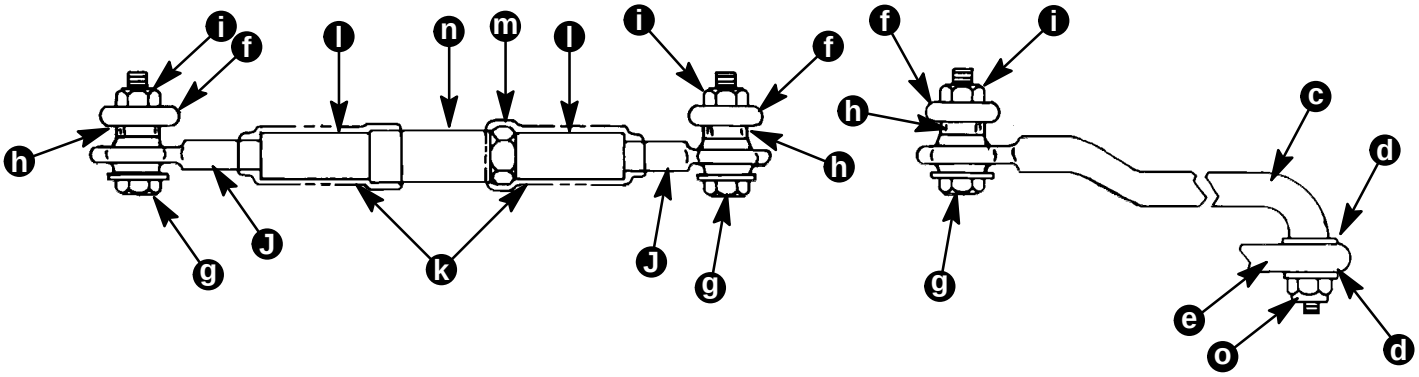
IMPORTANT: All 50-60 models with one piece top cowl require a minimum centerline distance of 21 in. (533mm) during dual outboard installation to assure interference-free movement.

MODELS WITH FORGED TWO HOLE STEERING ARM AND ONE PIECE TOP COWL

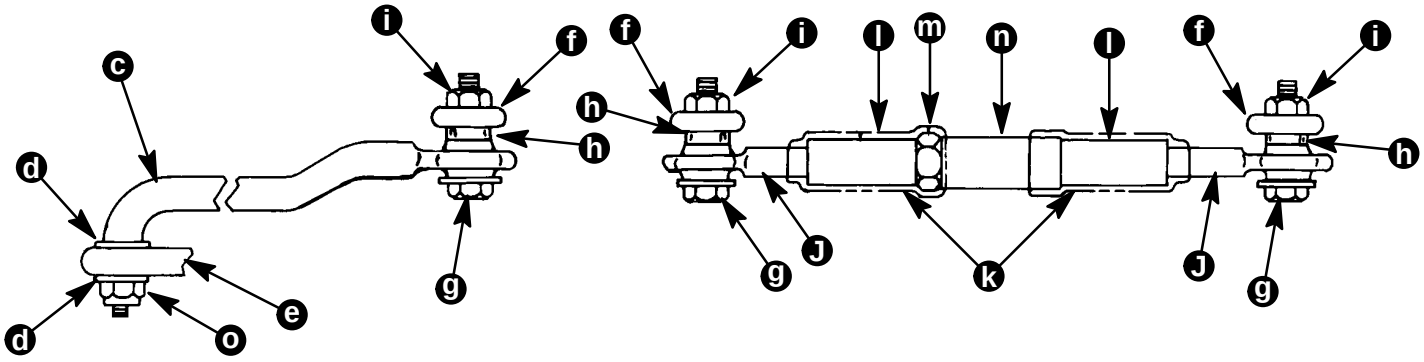


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Steering Cable Routed on Starboard Side of Boat Connected to Port Outboard

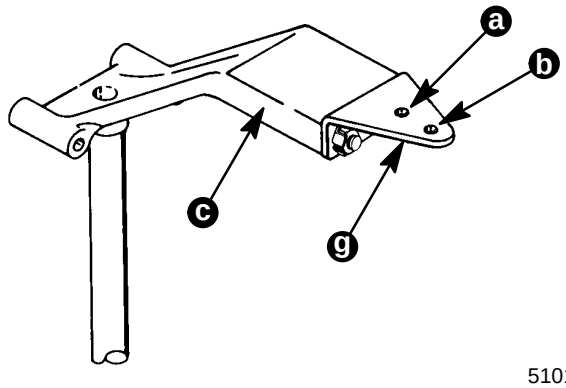


Steering Cable Routed on Port Side of Boat Connected to Starboard Outboard



a - Steering Link Connecting Hole
b - Coupler Assembly Connecting Hole
c - Steering Link
d - Washer
e - Ride-Guide Cable
f - Steering Bracket
g - Special (Washer Head) Bolt (3/8" x 1-5/8"; P/N 10-90041), Torque to 20 lb. ft. (27.1 N·m)
h - Special Washer (P/N 12-71970)
i - Lock Nut P/N 11-34863, Torque to 20 lb. ft. (27 N·m)
j - Steering Eye
k - Rubber Sleeve
l - Rubber Bushing
m - Jam Nut, Torque to 20 lb. ft. (27.1 N·m)
n - Dual Steering Coupler
o - Lock Nut P/N 11-34863, Torque Until it Seats [Do Not Exceed 120 lb. in. (14 N·m) of Torque], Then Back Off 1/4 Turn

MODELS WITH TWO HOLE TWO PIECE STEERING ARM/BRACKET AND ONE PIECE TOP COWL

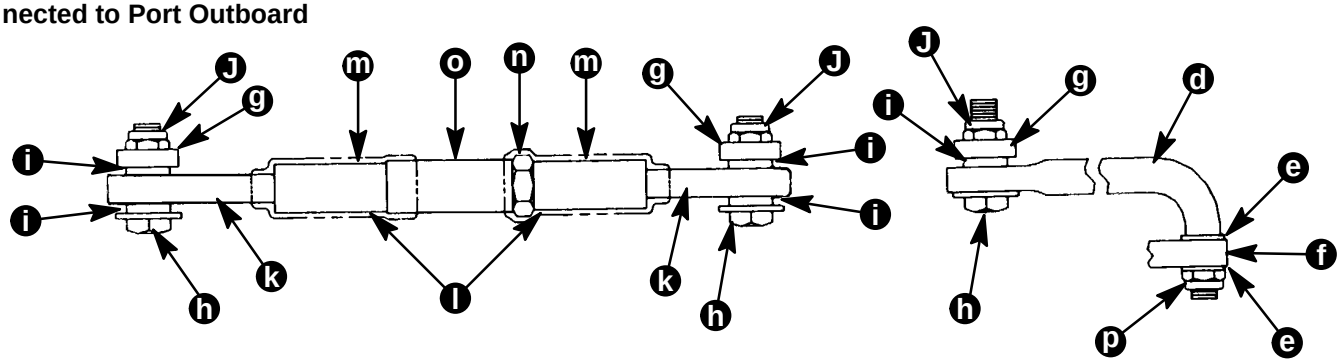


51011

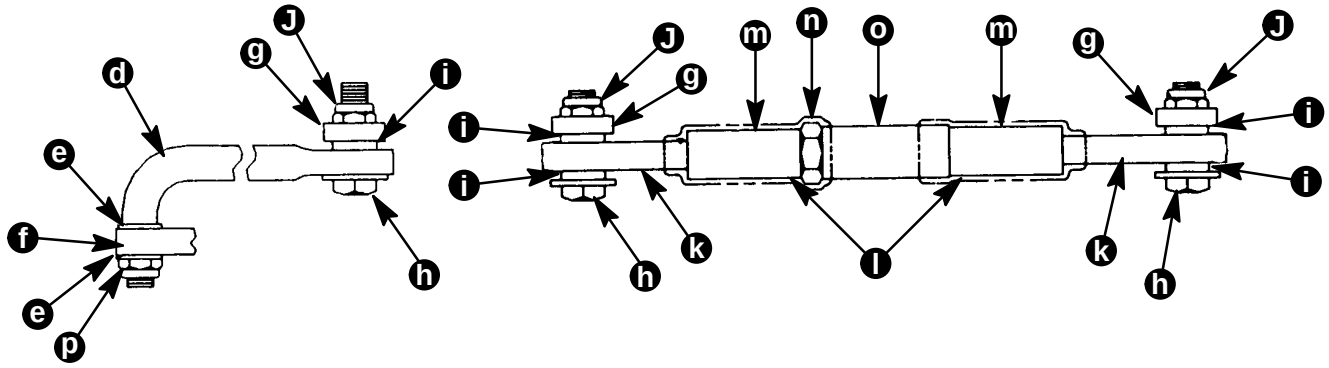
IMPORTANT: Lubricate all moving parts with Quicksilver 2-4-C w/Teflon Marine Lubricant.

IMPORTANT: All 50-60 models with one piece top cowl require a minimum centerline distance of 21 in. (533mm) during dual outboard installation to assure interference-free movement.

Steering Cable Routed on Starboard Side of Boat Connected to Port Outboard



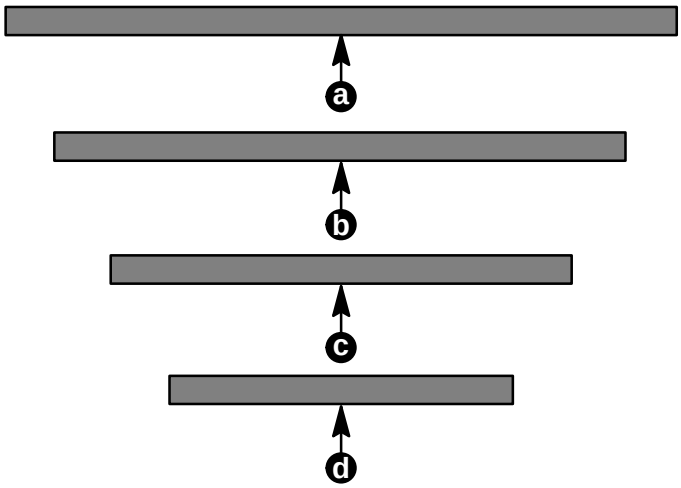
Steering Cable Routed on Port Side of Boat Connected to Starboard Outboard



a - Steering Link Connecting Hole
b - Coupler Assembly Connecting Hole
c - Steering Arm
d - Steering Link
e - Washer
f - Ride-Guide Cable
g - Steering Bracket
h - Special (Washer Head) Bolt (3/8" x 1-5/8"; P/N 10-90041), Torque to 20 lb. ft. (27 N·m)
i - Special Washer (P/N 12-71970)
j - Lock Nut P/N 11-34863, Torque to 20 lb. ft. (27 N·m)
k - Steering Eye
l - Rubber Sleeve
m - Rubber Bushing
n - Jam Nut, Torque to 20 lb. ft. (27.1 N·m)
o - Dual Steering Coupler
p - Lock Nut P/N 11-34863, Torque Until it Seats [Do Not Exceed 120 lb. in. (13.5 N·m) of Torque], Then Back Off 1/4 Turn

Ride-Guide Steering Attachment Extension Couplers

Outboard Center Line Distance	Required Coupler(s) Between Steering Eyes (Shown Below)
18 in. thru 22-1/2 in. (457mm thru 572mm)	9 in. (229mm) Coupler (p/n 814951--1)
22-1/2 in. thru 24-1/2 in. (572mm thru 622mm)	12 in. (305mm) Coupler (p/n 814951--2)
23-1/2 in. thru 27-1/2 in. (597mm thru 699mm)	15 in. (381mm) Coupler (p/n 814951--3)
26-1/2 in. thru 30-1/2 in. (673mm thru 755mm)	18 in. (457mm) Coupler (p/n 814951--4)



a - 18 in. (457mm) Coupler (P/N 814951--4)
b - 15 in. (381mm) Coupler (P/N 814951--3)
c - 12 in. (305mm) Coupler (P/N 814951--2)
d - 9 in. (229mm) Coupler (P/N 814951--1)

Trim Tab Adjustment

DUAL OUTBOARD

1. Check trim tab position as follows:

IMPORTANT: Initial trim tab setting for both outboards should be straight to rear of outboard, so that tabs are aligned with gear housing centerline. Refer to "If necessary, adjust trim tab as follows".

a. Operate boat at normal cruise throttle setting and adjust trim to optimum setting.

b. If boat pulls to the right (starboard), trailing edge of trim tab must be moved to the right (when viewing outboard from behind). If boat pulls to the left (port), trailing edge of trim tab must be moved to the left.

2. If necessary, adjust trim tab as follows:

a. Shift outboard into neutral and make sure ignition key is at "OFF" position.

b. Remove plastic cap from rear of drive shaft housing and loosen bolt and trim tab.

IMPORTANT: Trim tabs MUST BE set in the same position on both outboards.

c. If boat pulls to the right, adjust trailing edges of both trim tabs to the right. If boat pulls to the left, adjust trailing edges of both trim tabs to the left.

d. Tighten both trim tab bolts securely and replace plastic caps.

e. Operate boat following trim tab adjustment. Readjust trim tab if necessary.

Maintenance Instructions

Maintenance inspection is owner's responsibility and must be performed at intervals specified, following:

Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)

***Severe Service -** Every 25 hrs. of operation or 30 days (whichever comes first)

*Operation in a salt water area is considered "Sever Service".

1. Carefully check steering system components for wear. Replace worn parts.
2. Check steering system fasteners to be sure that they are torqued to correct specifications.

***NOTE:** Ride-Guide Steering Cables are lubricated at the factory and require no additional lubrication at initial installation.*

⚠ WARNING

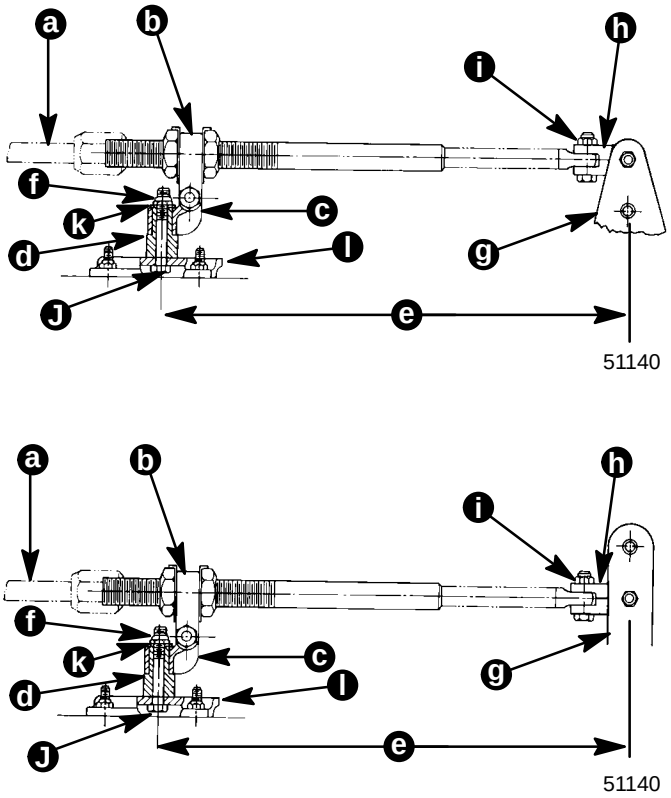
Core of each steering cable (transom end) must be fully retracted into cable housing before lubricating cable. If cable is lubricated while extended, hydraulic lock of cable could occur.

3. With core of Ride-Guide Steering Cable (transom end) fully retracted, lubricate transom end of steering cables thru grease fittings with 2-4-C w/Teflon Marine Lubricant. Lubricate exposed portion of cable ends with 2-4-C w/Teflon Marine Lubricant.
4. Lubricate pivot points of steering link rods and ball joints of link rods/steering coupler with Quicksilver 2-4-C w/Teflon Lubricant.
5. Inspection and lubrication of steering head assembly (rotary or straight rack) should be performed once each year (by your Authorized Dealer) or whenever steering mount and/or steering head are disassembled, or if steering effort has increased. Lubricate with 2-4-C w/Teflon Marine Lubricant.

Transom Mounted Ride-Guide Attaching Kit Installation

Attaching Kit Installation

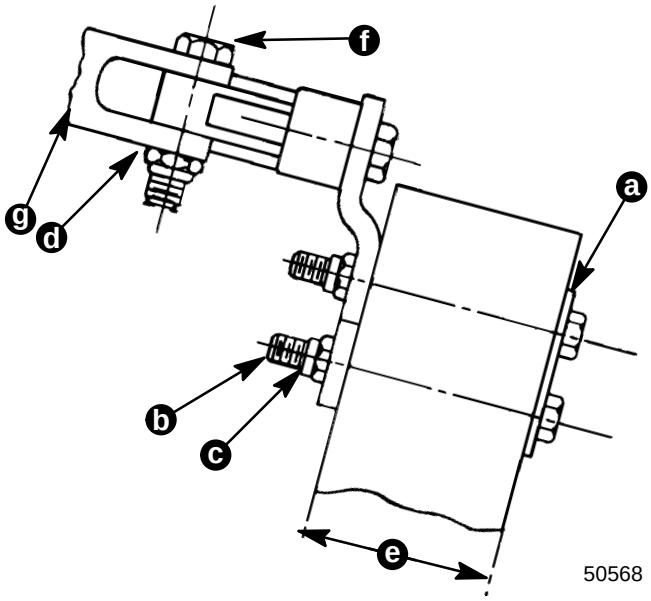
1. Lubricate both holes in pivot block (Figure 1) with Quicksilver 2-4-C w/Teflon Marine Lubricant.
2. Place pivot block on pivot spacer and secure to transom bracket with 3/8 in. x 2-1/2 in. bolt, flat washer and locknut, as shown in Figure 1. Torque locknut to 20 lb. ft (27 N·m).



a - Ride-Guide Cable
b - Ride-Guide Yoke
c - Pivot Block
d - Pivot Spacer
e - 15 in. (Centerline of Attaching Kit Pivot to Centerline of Outboard)
f - Pivot Attaching Locknut [Torque to 20 lb. ft. (27.1 N·m)]
g - Outboard Steering Arm or Steering Arm/Bracket
h - "Clevis Kit"
i - Ride-Guide Cable Attaching Locknut [Torque to 10 lb. ft. (13,5 N·m)
j - Bolt (3/8 in. x 2-1/2 in.)
k - Flat Washer
l - Transom Bracket

Figure 1. Installing Attaching Kit

3. Place Ride-Guide yoke on pivot block and secure with 7/16 in. x 1-3/4 in bolt and locknut, as shown in Figures 1 and 2. Torque locknut to 10 lb.ft. (13.5 N·m), **then back off 1/4 turn.**
4. Install one cable tube jam nut onto steering cable tube. Place tab washer over Ride-Guide yoke, then insert cable tube thru tab washer and yoke. Install second cable tube jam nut onto cable tube but do not tighten at this time. (Figure 3)
5. Position transom attaching kit on transom as follows:
   a. Determine centerline of outboard, then measure 15 in. (38.1cm) over from this centerline and draw a vertical line on transom. (Figure 1)
   b. Position attaching kit on transom so that **transom bracket is centered on the 15 in. line** (Figure 1) at a height where the **center of Ride-Guide yoke is even with, or not more than 1/2 in. (12.8mm)** above, top edge of transom. (Figure 3)



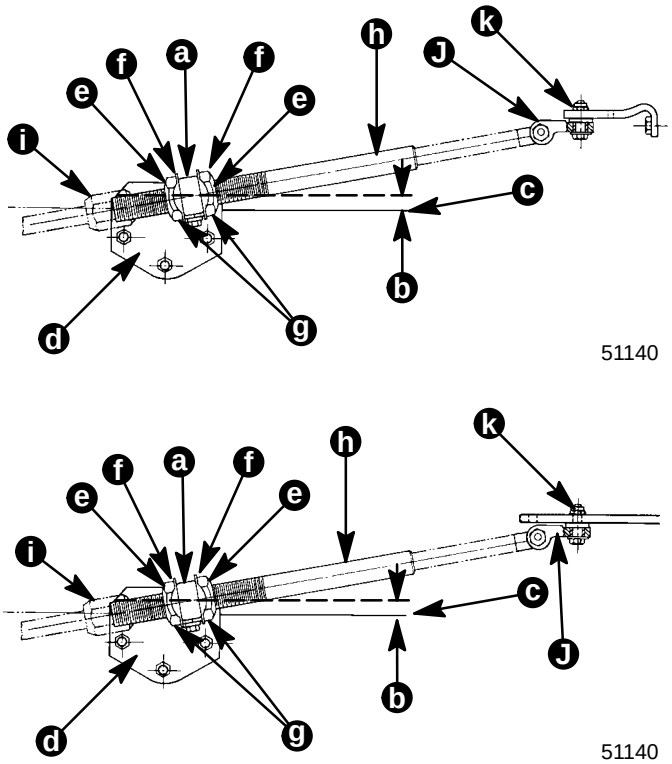
a - Transom Backing Plate
b - Bolt (5/16 in. x 3-1/4 in.)
c - Locknut (Torque to 10 lb. ft.)
d - Ride-Guide Yoke Attaching Locknut (Torque to 10 lb. ft. **Then Back Off 1/4-Turn**
e - 2-3/8 in. Maximum Transom Thickness
f - Bolt (7/16 in. x 1-3/4 in.)
g - Ride-Guide Yoke

Figure 2. Installing Attaching Kit

NOTE: *When drilling thru transom, be sure that holes are drilled perpendicular to transom.*

6. With attaching kit positioned as outlined preceding, use 3 holes in transom bracket as a guide and drill three 11/32 in. (8.7mm) holes thru transom.

7. Use a marine-type sealer on three 5/16 in. x 3-1/4 in. bolts. Secure attaching kit to transom, using transom backing plate, 3 bolts (with sealer) and 3 locknuts, installed as shown in Figure 2. Torque locknuts to 10 lb. ft. (13.5 N·m).



a - Ride-Guide Yoke
b - 0 in. to 1/2 in. (12.7 mm) (Center of Ride-Guide Yoke to Top of Transom)
c - Top of Transom
d - Transom Bracket
e - Cable Tube Jam Nuts [Torque to 35 lb. ft. (47.5 N·m)]
f - Tab Washer
g - After Jam Nuts are Torqued to Specification, Bend Locking Tabs Against Nuts
h - Cable Guide Tube
i - Ride-Guide Cable Attaching Nut [Torque to 35 lb. ft. (47.5 N·m)]
j - "Clevis Kit"
k - Clevis Attaching Locknut [Torque to 20 lb. ft. (27.1 N·m)

Figure 3. Installing Attaching Kit

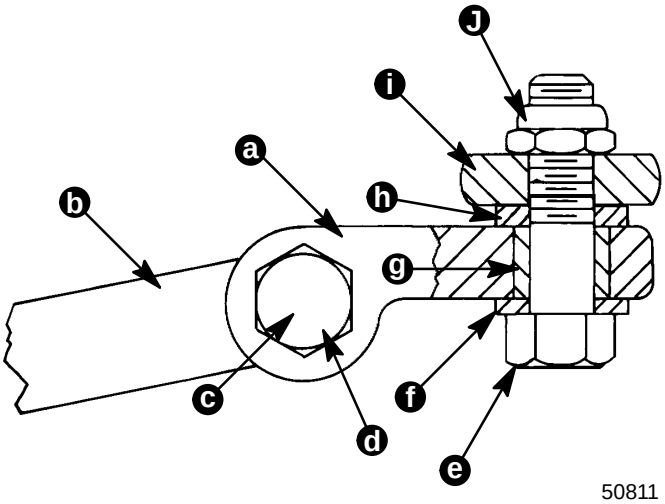
Clevis Attaching Kit Installation

NOTE: *This kit is used to attach Ride-Guide cable to outboard steering arm ONLY when "Transom Mounted Ride-Guide Attaching Kit" is being used. If Ride-Guide cable is installed thru outboard tilt tube, then "Steering Link Rod" must be used.*

Installation Instructions

⚠CAUTION

Models with two hole two piece steering arm require outer connection hole to be used when connecting clevis to steering arm.



a - Clevis
b - Steering Cable
c - Bolt (3/8 in. x 1-3/8 in.)
d - Clevis to Steering Cable Locknut [Torque to 10 lb. ft. (13.5 N·m)]
e - Bolt 3/8 in. x 1-1/4 in. [Torque to 20 lb. ft. (27.0 N·m)]
f - Thin Washer [1/16 in. (1.6mm) Thick]
g - Spacer
h - Thick Washer [1/8 in. (3.2mm) Thick]
i - Outboard Steering Arm (use Inner Hole on Models with One Piece Steering Arm or Outer Hole on Models with Two Hole Two Piece Steering Arm)
j - Clevis to Outboard Locknut [Torque to 20 lb. ft. (27.0 N·m)]

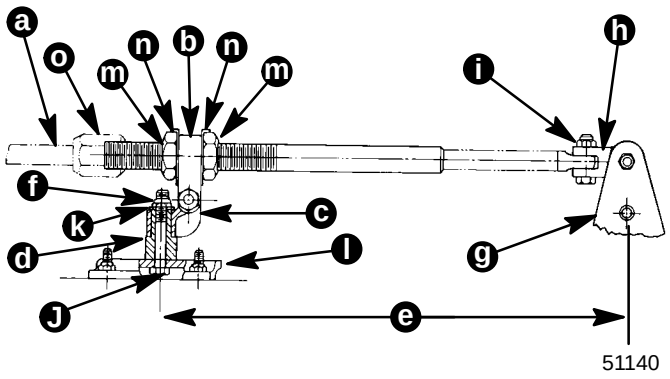
1. Lubricate shank of bolt (c) with 2-4-C w/Teflon Marine Lubricant, then secure clevis to steering cable with this bolt and locknut. Torque locknut (d) to 10 lb. ft (13.5 N·m).

2. Lubricate spacer (supplied with kit) with 2-4-C w/Teflon Marine Lubricant.

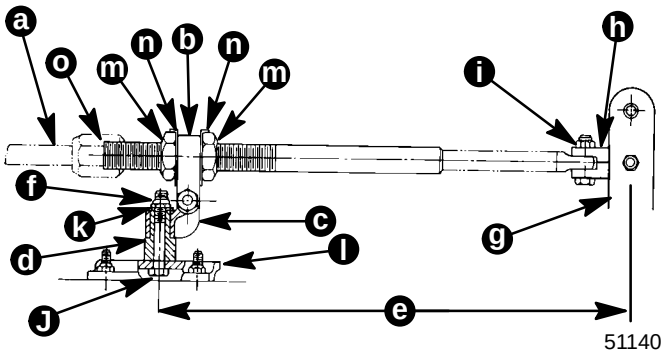
3. Attach clevis to steering arm bolt using thin washer, spacer, thick washer (positioned between clevis and steering arm) and locknut, as shown. Torque bolt (e) to 20 lb. ft (27.0 N·m), then torque locknut (j) to 20 lb. ft. (27.0 N·m).

Steering Cable Installation

1. Lubricate steering cable end with Quicksilver 2-4-C w/ Teflon Marine Lubricant.
2. Install steering cable thru steering cable tube and secure to cable tube with cable attaching nut. (See below.) Do not tighten cable attaching nut at this time.
3. Attach ride-guide cable to outboard steering bracket (middle hole) using clevis kit (P/N 70599A4).
4. Adjust 2 large jam nuts on cable tube of attaching kit, so that **steering wheel** is in normal straight-driving position with outboard in straight- driving position. Torque each jam nut to 35 lb. ft. (47.5 N·m), then bend a side of tab washer against flat of each jam. (below)
5. Torque Ride-Guide cable attaching nut (which secures cable to guide tube) to 35 lb. ft. (47.5 N·m). (below) Install locking sleeve over cable attaching nut and secure with cotter pin. Spread ends of cotter pin.



51140



51140

a - Ride-Guide Cable
b - Ride-Guide Yoke
c - Pivot Block
d - Pivot Spacer
e - 15" (Centerline of Attaching Kit Pivot to Centerline of Engine)
f - Pivot Attaching Locknut; Torque to 20 lb. ft. (27 N·m)
g - Engine Steering Arm
h - Clevis Kit
i - Ride-Guide Cable Attaching Locknut; Torque to 10 lb. ft. (13.5 N·m)
j - Bolt (3/8" x 2-1/2")
k - Flat Washer
l - Transom Bracket
m - Cable Tube Jam Nut; Torque to 35 lb. ft. (47.5 N·m)
n - Tab Washers (Bend Over Flat of Jam Nuts)
o - Cable Attaching Nut

NOTE: *Some Ride-Guide steering cables may not be equipped with locking sleeve and cotter pin. If cable being installed does not have these parts, disregard instructions to install them.*

⚠ WARNING

After installation is completed (and before operating outboard), check that boat will turn right when steering wheel is turned right and that boat will turn left when steering wheel is turned left. Check steering thru full range (left and right) at all tilt angles to assure interference-free movement.

6. Lubricate outboard end of Ride-Guide steering cable (thru grease fitting next to cable attaching nut) with Quicksilver 2-4-C w/Teflon Marine Lubricant.

NOTE: *Ride-Guide steering cable is lubricated at the factory and requires no additional lubrication at initial installation.*

7. Lubricate all steering system pivot points (and exposed portion of steering cable core) with Quicksilver 2-4-C w/Teflon Marine Lubricant. Lubricate at intervals specified preceding.
8. Carefully check steering system components for wear (at intervals specified, preceding). Replace worn parts.
9. Check steering system fasteners (at intervals specified, preceding) to be sure that they are torqued to correct specifications. (Figures 1, 2 and 3)

Maintenance Instructions

Lubrication and maintenance inspection is owner's responsibility and must be performed at intervals as specified following:

Normal Service - Every 50 hours of operation or 60 days (whichever comes first).

***Severe Service -** Every 25 hours of operation or 30 days (whichever comes first).

*Operation in salt water is considered "Severe Service".

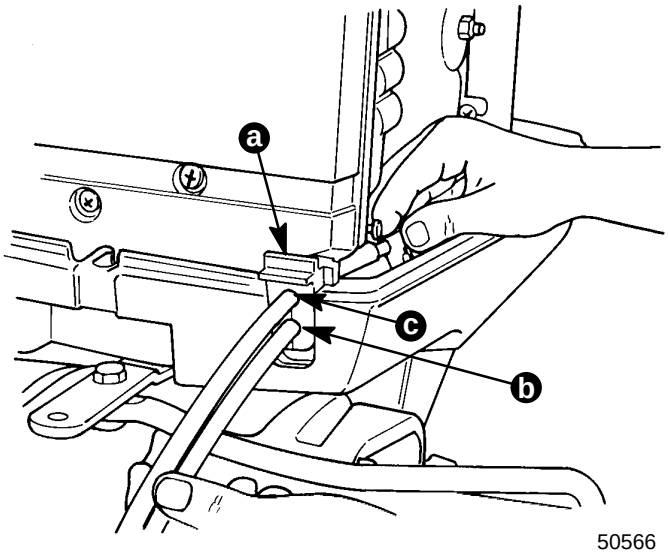
1. Carefully check steering components for wear. Replace as necessary.
2. Check steering system fasteners to be sure that they are torqued to correct specifications.
3. Lubricate clevis points with a drop of light oil.
4. Inspection and lubrication of steering system should be performed once each year or whenever steering components are disassembled, steering effort has increased or steering seems loose.

Remote Control Installation

IMPORTANT: Connect control cables to remote control and mount remote control BEFORE attaching control cables to engine.

Install throttle and shift cables to remote control and mount remote control as outlined in the installation instructions which accompany the remote control.

NOTE: *It will be necessary to lift control cable rubber grommet out of opening in bottom cowl. so that control cables can be routed thru grommet and into bottom cowl.*



50566

a - Control Cable Rubber Grommet
b - Shift Cable Opening
c - Throttle Cable Opening

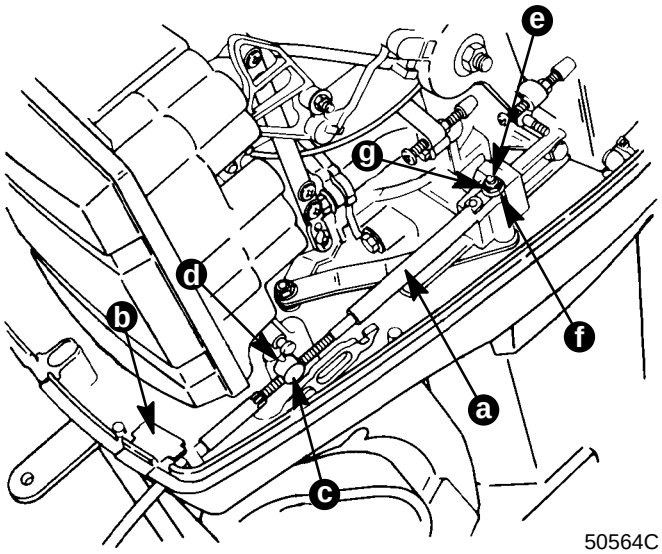
Shift Cable Installation and Adjustment to Engine

NOTE: *Attach shift cable to engine first. Shift cable is the first cable to move when remote control handle is advanced from neutral position toward in-gear position.*

If remote control has a neutral lock release, secure the release in the depressed position using a piece of tape. Now the true neutral detent can be found.

NOTE: *Move remote control handle back and forth. You will feel three detent positions; center detent is neutral.*

1. Position remote control handle into neutral detent.
2. Manually shift outboard into neutral (propeller will rotate freely).
3. Route shift cable (a) thru control cable grommet (b).
4. Adjust cable barrel (c) to attain the same length between cable barrel and hole in end of cable as exists between barrel receptacle (d) and shift actuator stud (e), keep a slight preload toward reverse.
5. Place end of shift cable on actuator stud (e), then place plastic washer (f) on stud and secure with locknut (g).

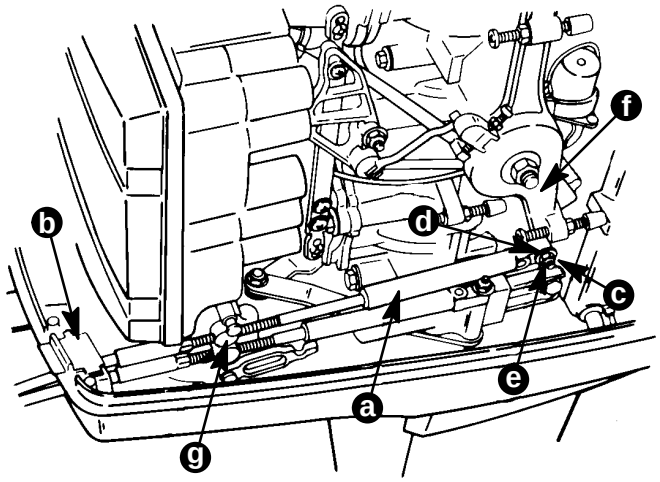


50564C

6. Check shift cable adjustment as follows:
   a. **Shift remote control into forward gear.** Now, check prop shaft, the shaft should not be able to turn counterclockwise. If it does, adjust cable barrel closer to cable end guide.
   b. **Shift remote control into neutral.** The prop shaft now should turn freely without drag. If not, adjust cable barrel away from cable end guide. Repeat steps a and b.
   c. **Shift remote control into reverse as the prop shaft is rotated by hand.** The prop shaft should not be able to turn clockwise. If it does, adjust cable barrel away from cable end guide. Repeat steps a thru c.
   d. **Shift remote control into neutral.** The prop shaft should turn freely without drag. If not, adjust cable barrel closer to cable end guide. Repeat steps a thru d.

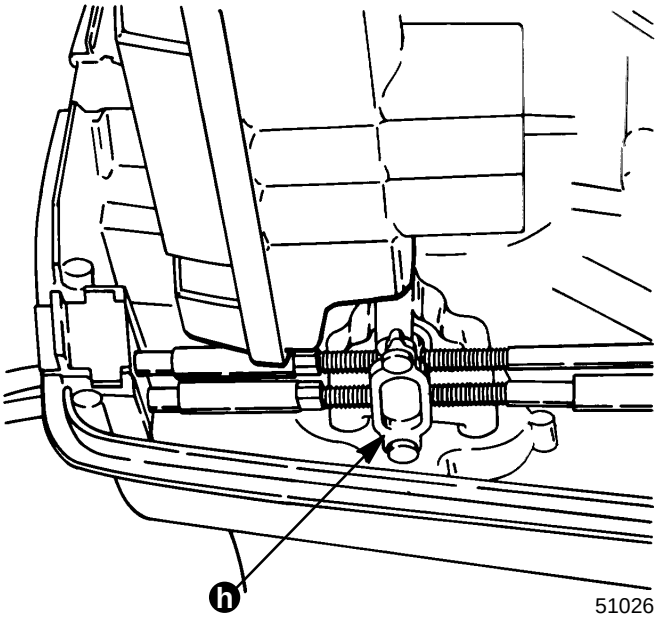
Throttle Cable Installation and Adjustment to Engine

1. Shift remote control into neutral.
2. Route throttle cable (a) thru control cable grommet (b).
3. Install throttle cable end (a) onto stud (c) of throttle lever. Place nylon washer (d) over stud and install locknut (e). Tighten locknut against throttle cable end to snug cable end against throttle lever, then back locknut off 1/4 turn.
4. Holding engine throttle lever (f) against idle stop, adjust throttle cable barrel (g) to slip into upper hole of barrel receptacle, with a very light preload of throttle lever against idle stop.



50564D

5. Lock barrels in place with barrel retainer (h).
6. Check preload on throttle cable by placing a thin piece of paper between idle stop screw and idle stop. Preload is correct when paper can be removed without tearing, but has some drag on it. Re-adjust cable barrel, if necessary.

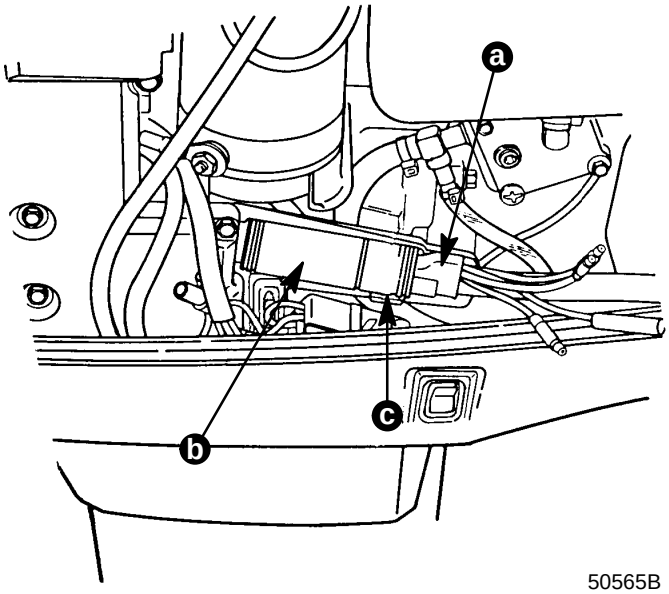


51026

Connecting Remote Control Wiring Harness to Engine Wiring Harness (Electric Start Models)

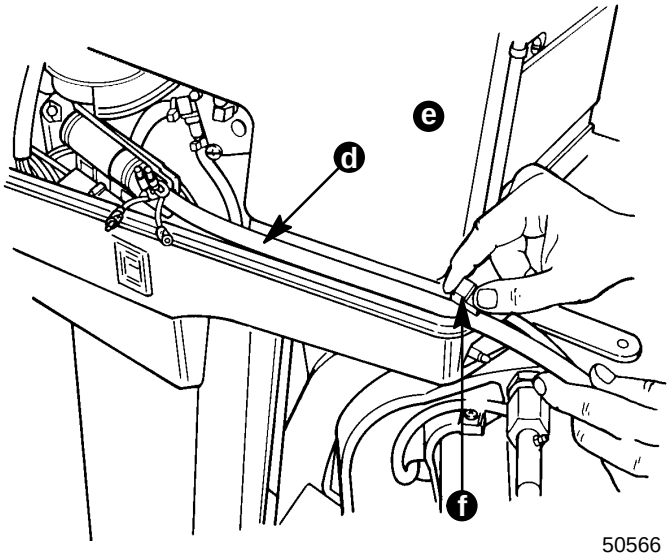
Route remote control harness or key switch harness along side of boat to engine, fastening harness to boat. Be sure that harness does not rub, get pinched or come in contact with bilge water.

Plug remote control harness or key switch harness connector (a) into engine harness connector (b) and push connection securely into retainer (c).



50565B

Route remote control harness or key switch harness (d) along side oil tank (e) and out of bottom cowl thru opening (f) in battery cable grommet.



50566

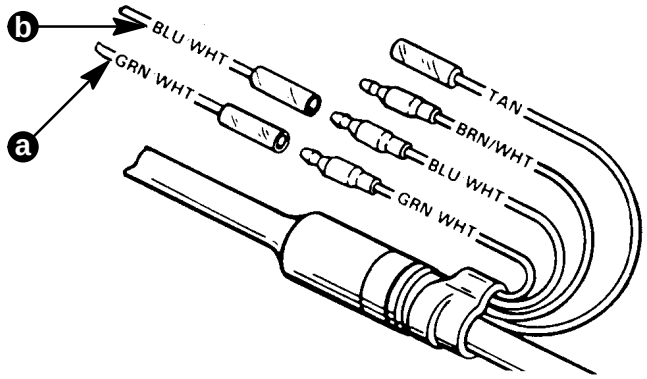
⚠ CAUTION

Remote control wiring harness and key switch wiring harness must be routed between control cable rubber grommet and engine harness connector, so that harness will not interfere with engine throttle and shift operation.

Power Trim Wiring Connections (Models So Equipped)

Make bullet connector wiring connection, between remote control wiring harness/key switch wiring harness and engine wiring.

IMPORTANT: Tape back and isolate any unused wiring harness leads.



a - Lead From Trim Solenoid (Down Solenoid)
b - Lead From Trim Solenoid (Up Solenoid)

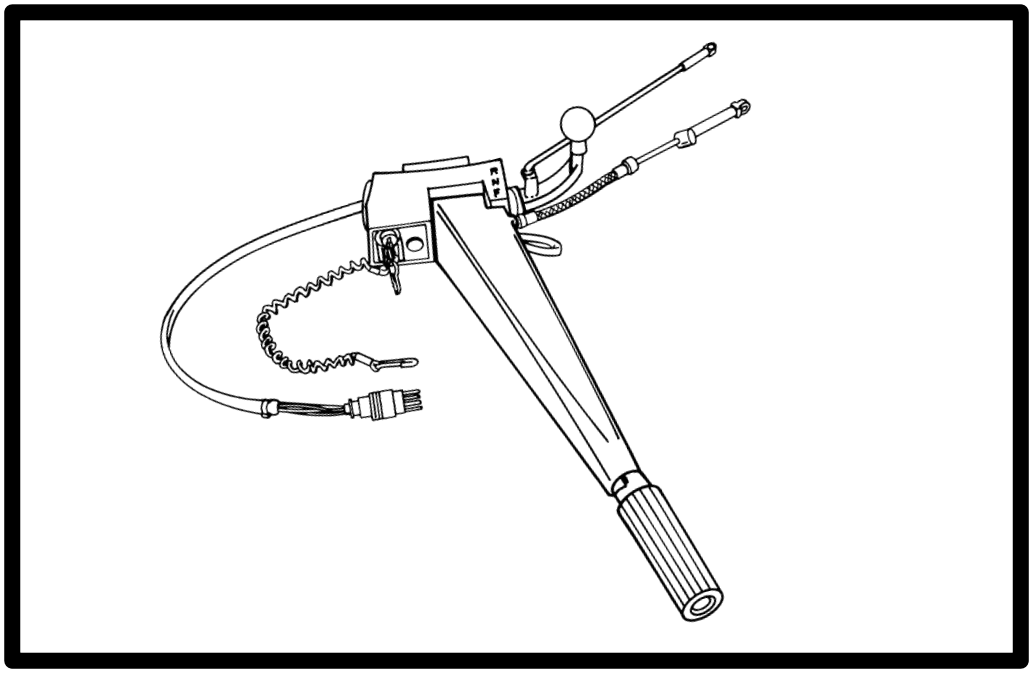
Battery Connections

⚠ CAUTION

Failure to observe correct polarity when connecting battery cables to battery will result in damage to the charging system.

1. Connect battery cables (from engine) to battery. Connect red battery cable to positive (+) battery terminal and black battery cable to negative (-) battery terminal.

OUTBOARD INSTALLATION/ ATTACHMENTS



TILLER HANDLE and CO-PILOT

7

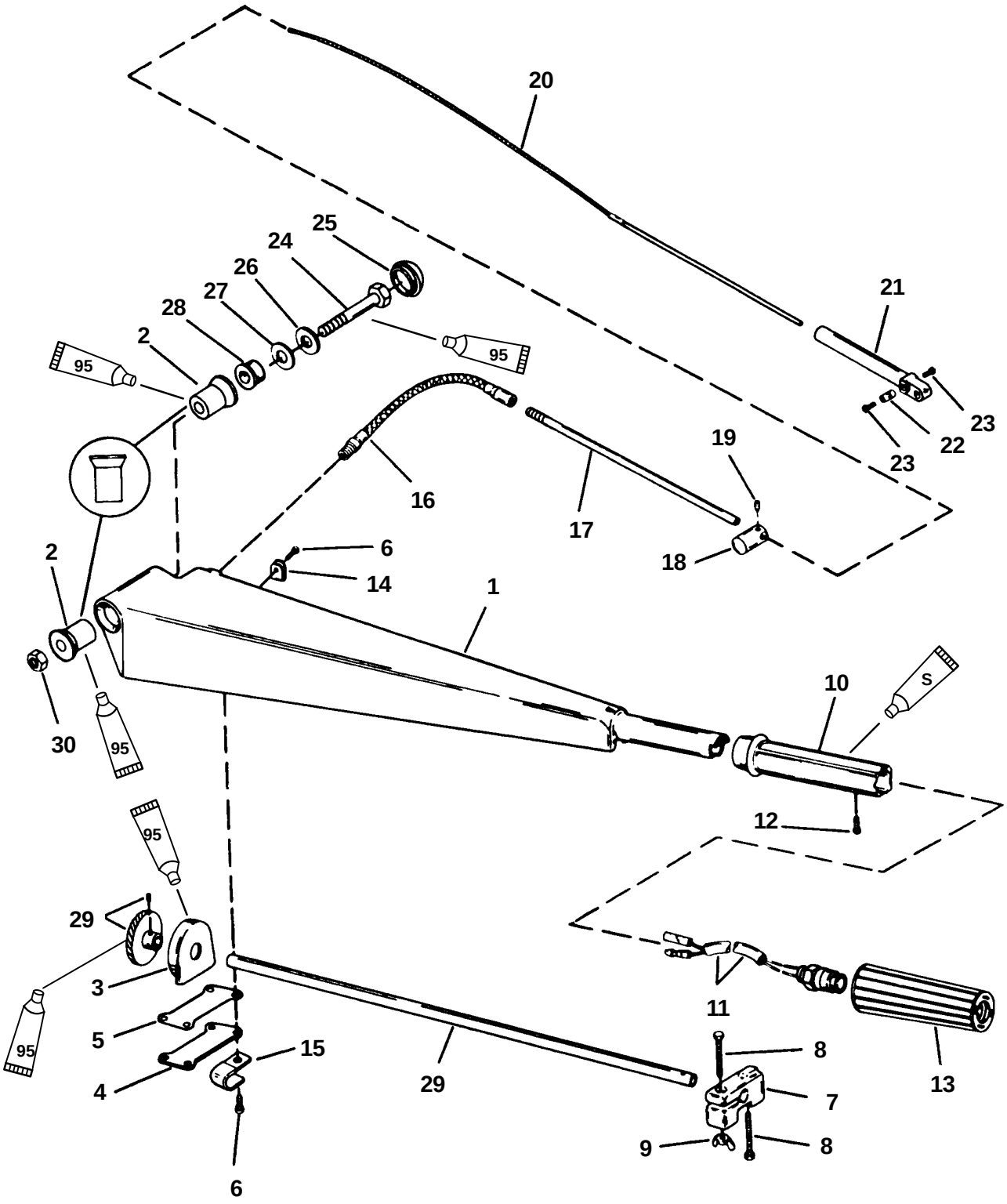
B

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Notes:

Steering Handle Kit



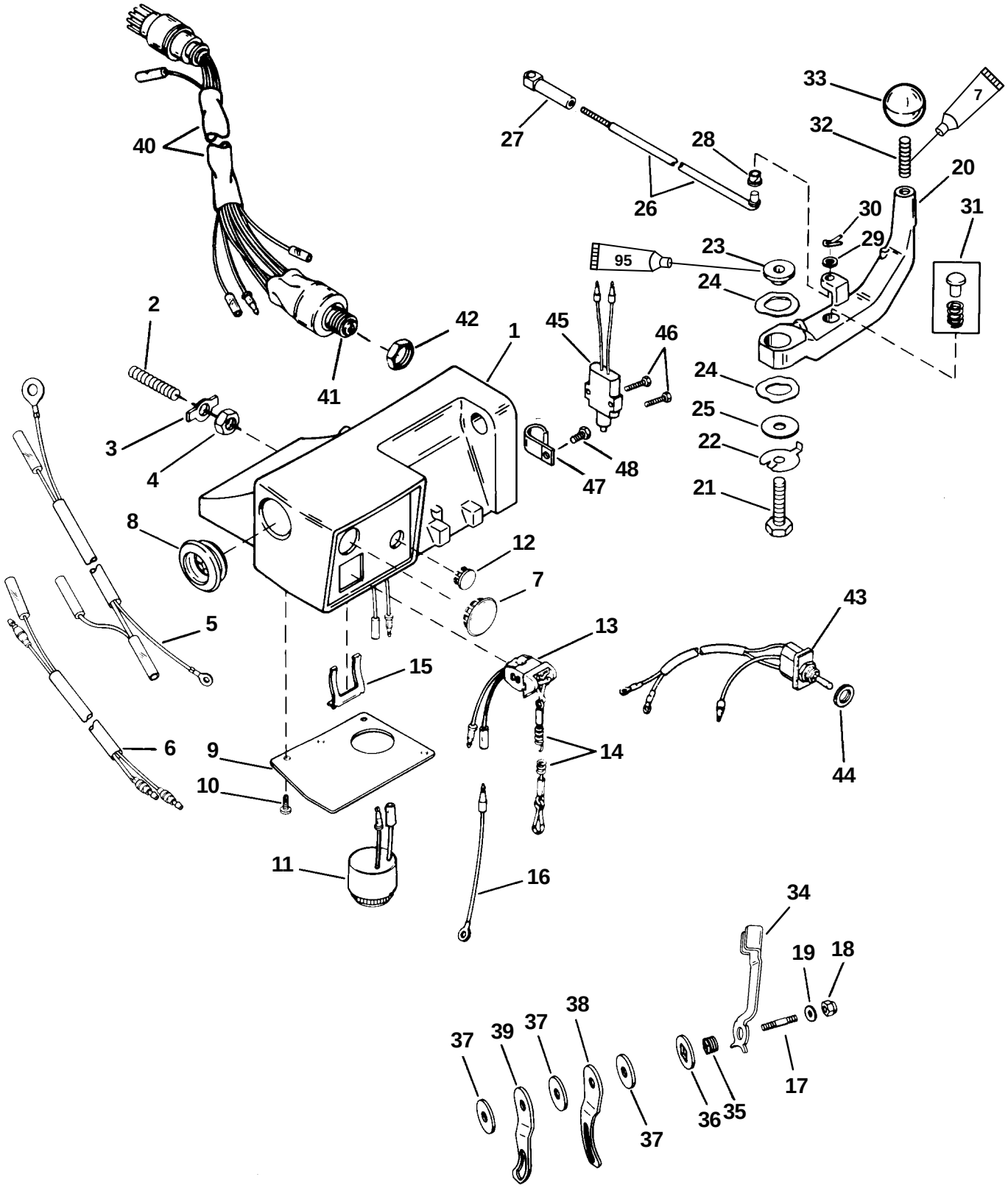
95 2-4-C With Teflon (92-825407A12)

S 2-4-C Soapy Water Solution (Obtain Locally)

Steering Handle Kit

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	STEERING ARM			
2	2	BUSHING			
3	1	HOUSING			
4	1	PLATE			
5	1	GASKET			
6	6	SCREW (1/2 IN.)	Drive Tight		
	1	SCREW (3/5 IN.)	Drive Tight		
7	1	CLAMP			
8	2	SCREW	40		4.5
9	1	WING NUT			
10	1	THROTTLE HANDLE/STOP SWITCH KIT			
11	1	STOP SWITCH			
12	1	SCREW	Drive Tight		
13	1	GRIP			
14	1	J-CLAMP			
15	1	J-CLAMP			
–	1	THROTTLE CABLE KIT			
16	1	CONDUIT			
17	1	GUIDE TUBE			
18	1	BARREL			
19	1	SET SCREW	Drive Tight		
20	1	CABLE			
21	1	GUIDE			
22	1	ANCHOR			
23	2	SET SCREW	Drive Tight		
24	1	SCREW		40	54.0
25	1	CAP			
26	1	WASHER			
27	1	WASHER			
28	1	SPACER			
29	1	THROTTLE TUBE			
30	1	NUT		40	54.0

Steering Handle Kit



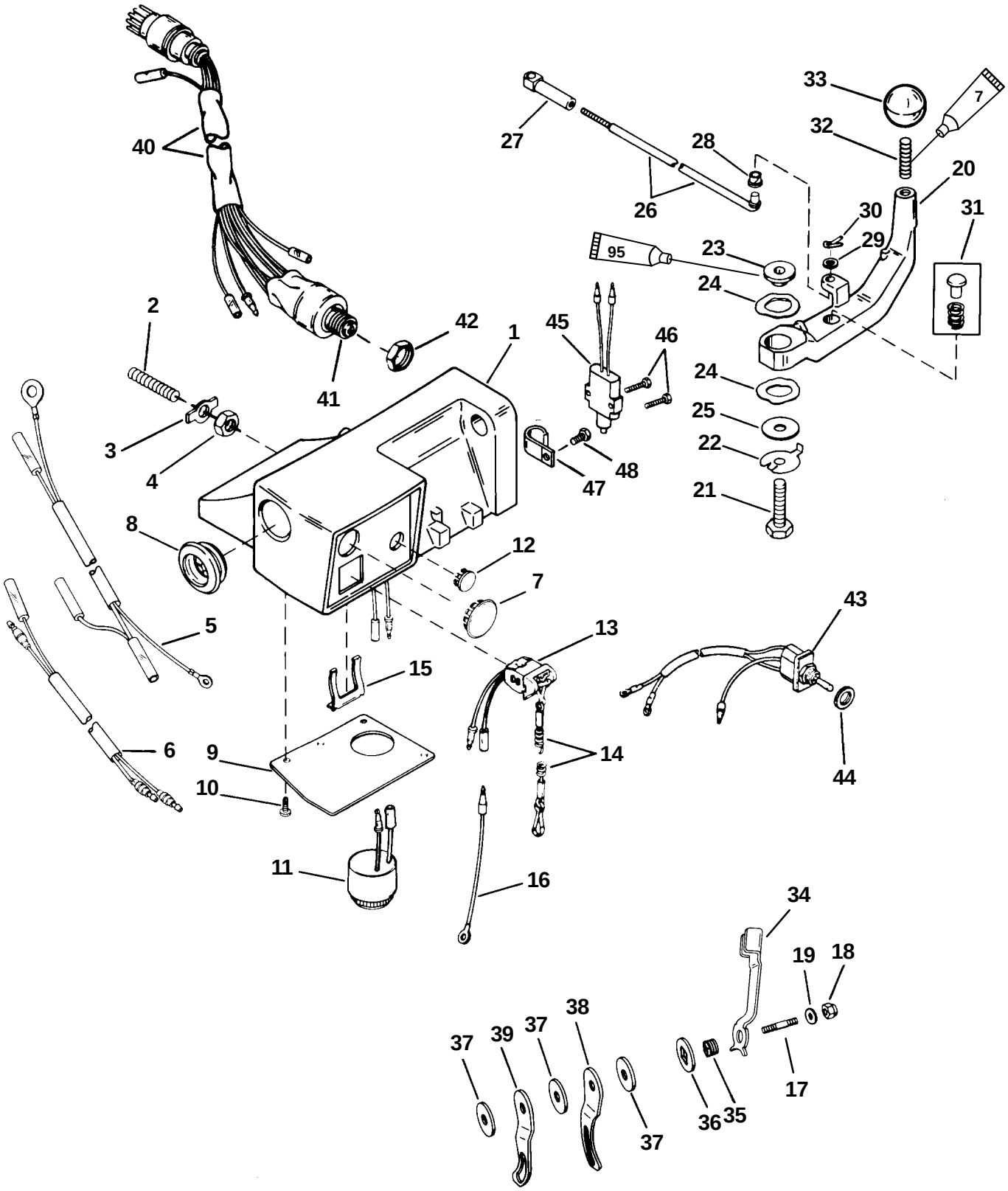
7 Loctite 271 (92-809820)

95 2-4-C With Teflon (92-825407A12)

Steering Handle Kit

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	BRACKET			
2	2	STUD			
3	2	TAB WASHER			
4	2	NUT		35	47.5
5	1	STOP HARNESS			
6	1	CABLE			
7	1	PLUG			
8	1	GROMMET			
9	1	COVER			
10	4	SCREW	Drive Tight		
11	1	HORN			
12	1	PLUG			
13	1	STOP SWITCH			
14	1	LANYARD			
15	1	RETAINER			
16	1	CABLE			
17	1	STUD			
18	1	NUT	75		8.5
19	1	WASHER			
20	1	SHIFT LEVER			
21	1	SCREW	70		8.0
22	1	TAB WASHER			
23	1	BUSHING			
24	1	WASHER **(BELLEVILLE)**			
	1	WASHER **(PLASTIC)**			

Steering Handle Kit



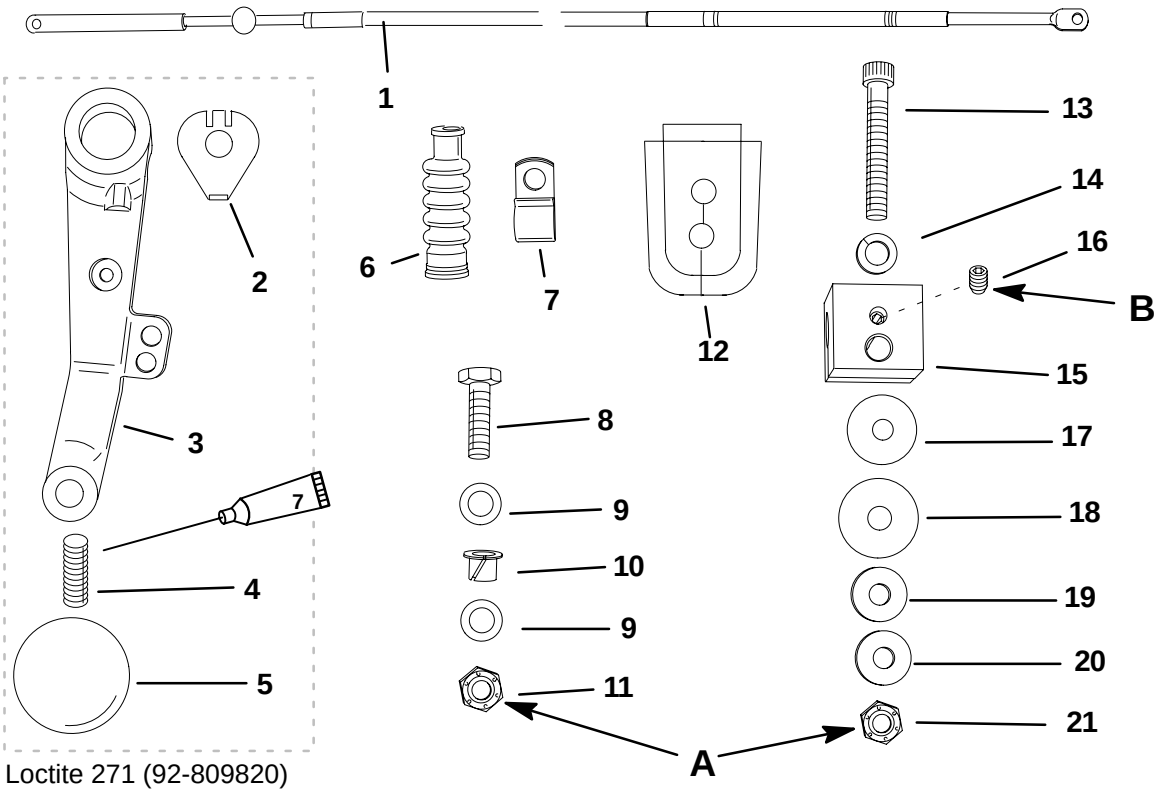
7 Loctite 271 (92-809820)

95 2-4-C With Teflon (92-825407A12)

Steering Handle Kit

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
25	1	WASHER			
26	1	SHIFT ROD			
27	1	ROD END			
28	1	BUSHING			
29	1	WASHER			
30	1	COTTER PIN			
31	1	DETENT ASSEMBLY			
32	1	STUD			
33	1	KNOB			
34	1	CO-PILOT LEVER			
35	1	CO-PILOT DRIVER			
36	1	WASHER			
37	3	BRAKE DISC			
38	1	ARM (TOP)			
39	1	ARM (BOTTOM)			
40	1	HARNESS ASSEMBLY			
41	1	KEY SWITCH			
42	1	NUT			
43	1	TRIM SWITCH			
44	2	NUT			
45	1	SWITCH ASSEMBLY			
46	2	SCREW	Drive Tight		
47	1	CLAMP			
48	1	SCREW	Drive Tight		

Tiller Handle Adaptor Kit (JET 45)



7 Loctite 271 (92-809820)

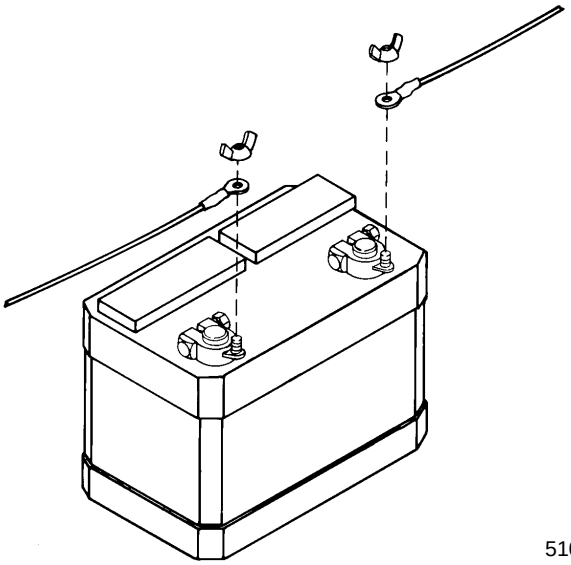
A – Drive tight and then back off 1/4 turn.

B – Tighten until snug and then tighten an additional 1/8 turn.

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
–	1	TILLER HANDLE ADAPTOR KIT			
1	1	SHIFT CABLE			
2	1	TAB WASHER			
3	1	SHIFT LEVER			
4	1	STUD			
5	1	SHIFT KNOB			
6	1	CABLE BOOT			
7	1	J CLIP			
8	1	SCREW (1/4-20 x 7/8)			
9	2	WASHER			
10	1	BUSHING			
11	1	NUT			
12	1	CABLE SEAL			
13	1	SCREW (1/4-28 x 1-3/4)			
14	1	LOCKWASHER			
15	1	RETAINER			
16	1	SET SCREW			
17	1	WASHER			
18	1	WASHER			
19	1	WASHER			
20	1	WASHER			
21	1	NUT			

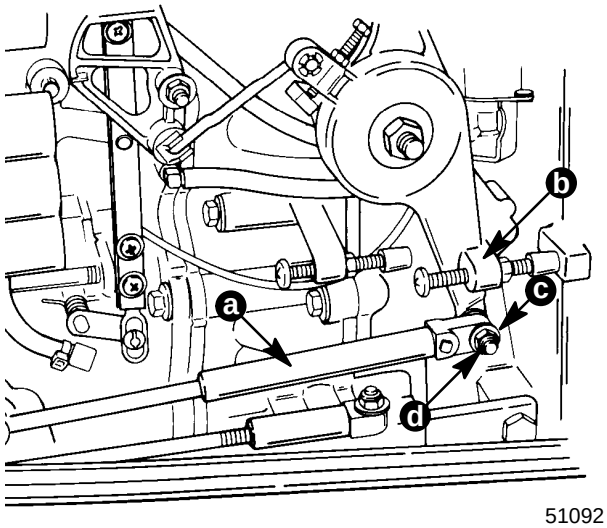
Tiller Arm/Shift Lever Removal

1. Remove battery cables from battery.



51084

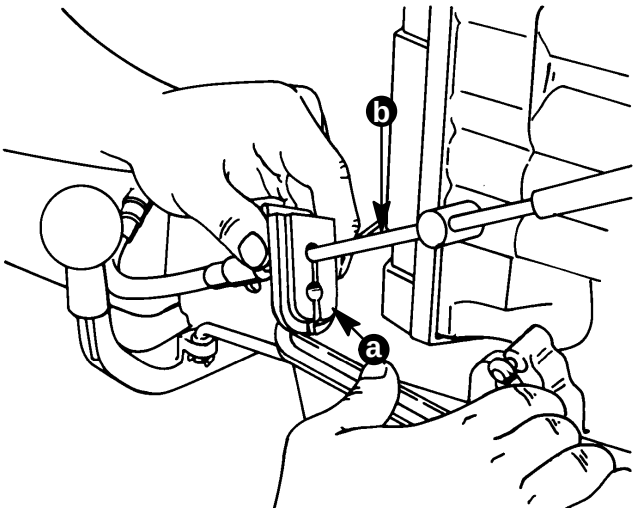
2. Remove outboard cowling.
3. Remove nut securing throttle cable to engine.



51092

a - Throttle Cable
b - Throttle Lever
c - Washer
d - Locknut

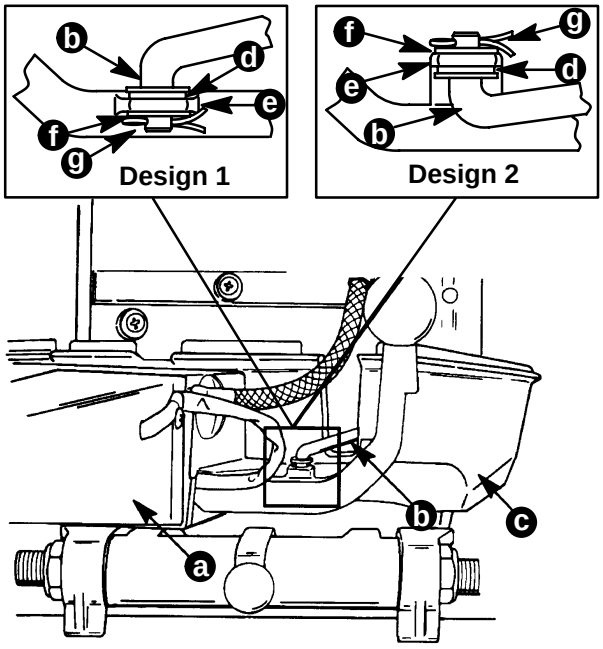
4. Release latch and remove throttle cable with grommet from bottom cowl.



51093

a - Rubber Grommet
b - Throttle Cable

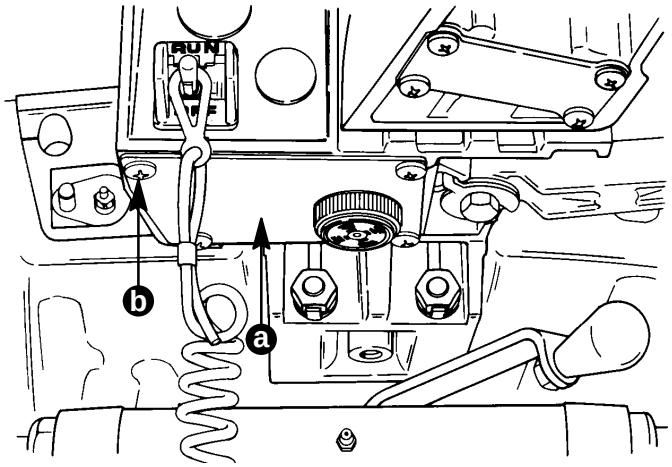
5. Remove cotter key from shift rod.



54256

a - Tiller Handle
b - Shift Rod
c - Lower Cowl
d - Bushing
e - Shift Handle
f - Washer
g - Cotter Key

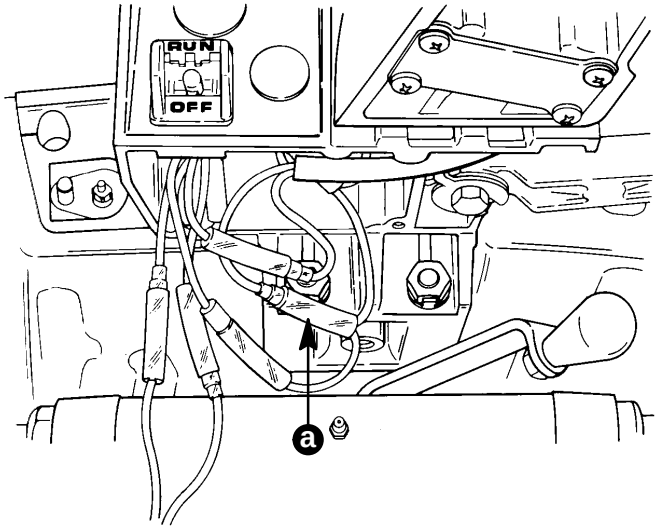
6. Remove cover.



51608

a - Cover
b - Screw (4)

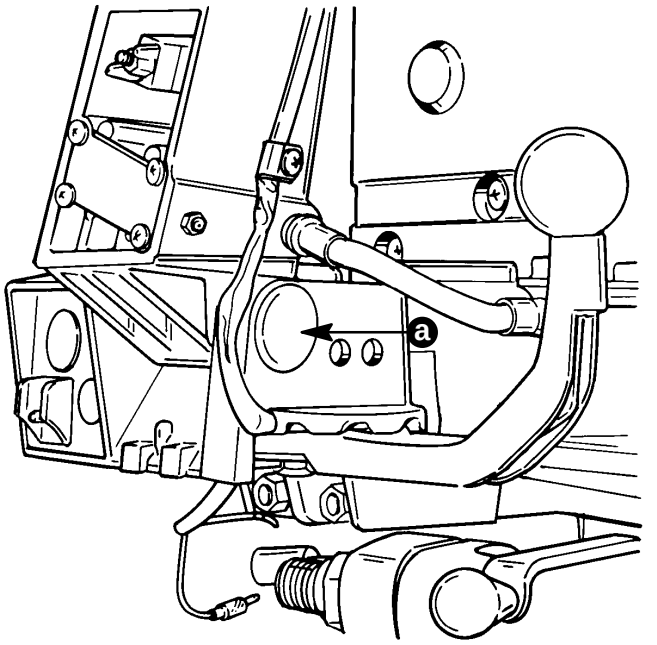
7. Disconnect stop switch wire at bullet connector and screw securing ground wire.



51608

a - Stop Switch Wire (Bullet Connector)

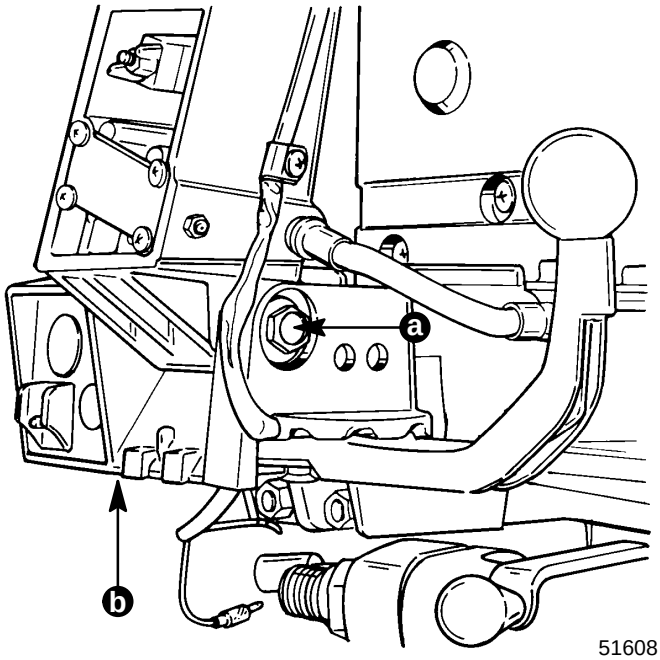
8. Remove plug from tiller handle bracket.



51608

a - Plug

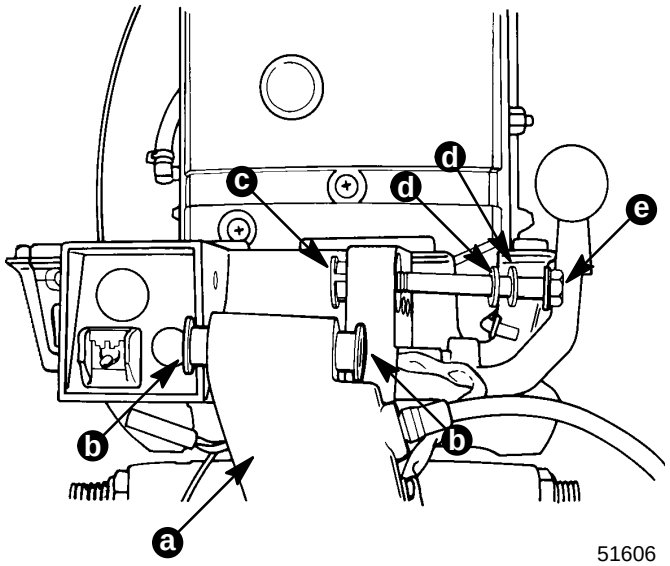
9. Remove bolt and nut from tiller handle bracket.



51608

a - Bolt
b - Nut (Hidden)

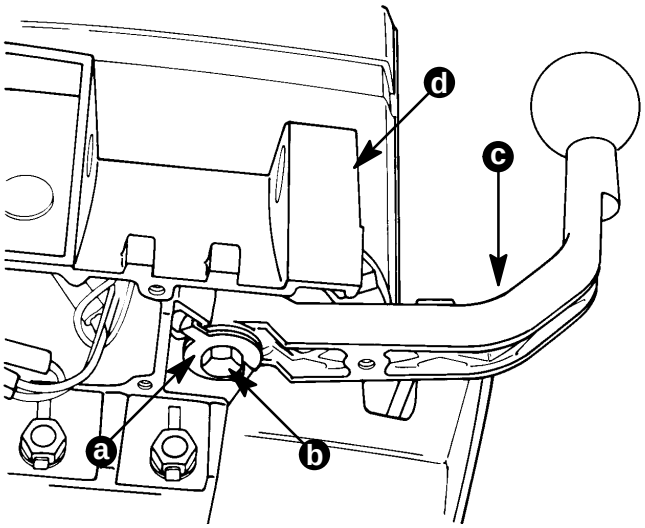
10. Remove tiller handle, 2 nylon bushings, stainless steel spacer and 2 flat washers from bracket.



51606

a - Tiller Handle
b - Nylon bushing (2)
c - Stainless Steel Spacer
d - Washer (2)
e - Bolt

11. Bend tab washer away form bolt securing shift lever and remove bolt and lever from bracket.

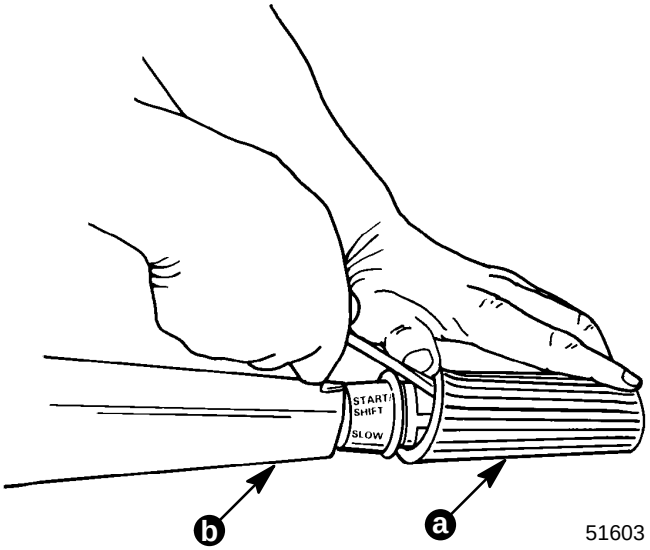


51606

a - Tab Washer
b - Bolt
c - Shift Lever
d - Bracket

Tiller Handle Disassembly

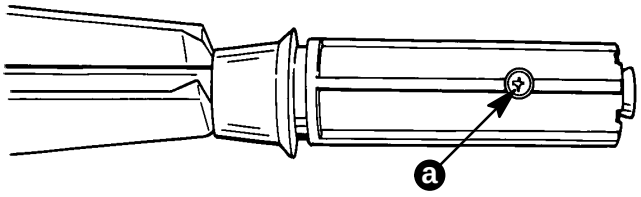
1. Using a flat tip screwdriver, carefully pry/push rubber grip off tiller handle.



51603

a - Grip
b - Tiller Handle

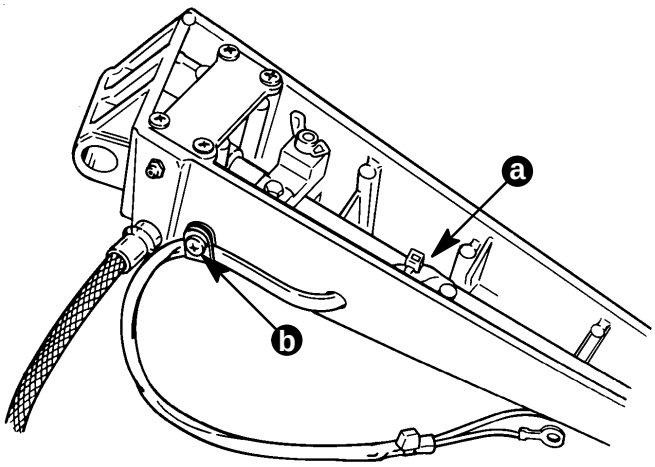
2. Remove screw from twist grip.



51603

a - Screw

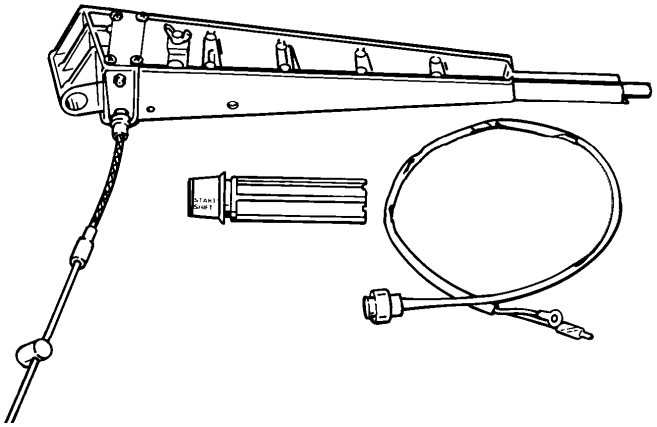
3. Cut sta-strap securing stop switch harness and remove screw from harness J-clip.



51603

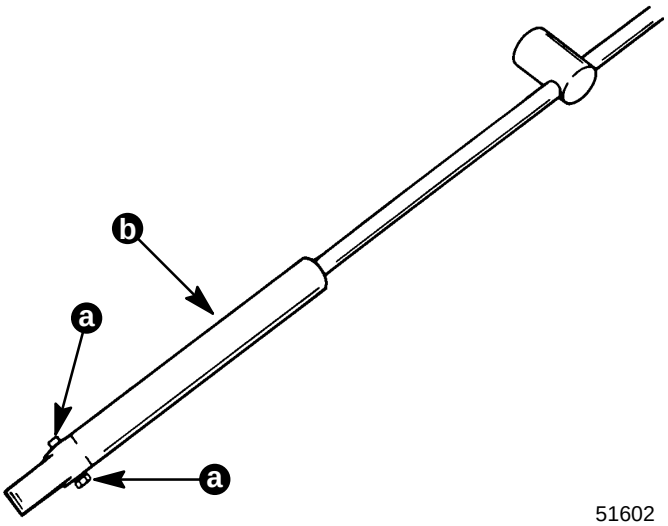
a - Sta-Strap
b - Screw

4. Remove stop switch and twist grip from tiller handle.



51603

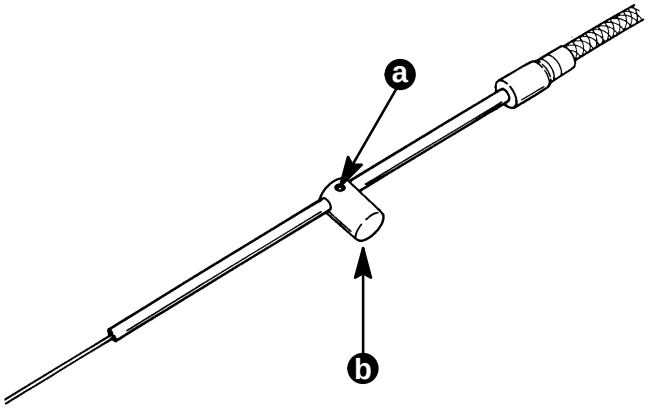
5. Remove throttle cable anchor screws and remove cable guide.



51602

a - Anchor Screws
b - Throttle Cable Guide

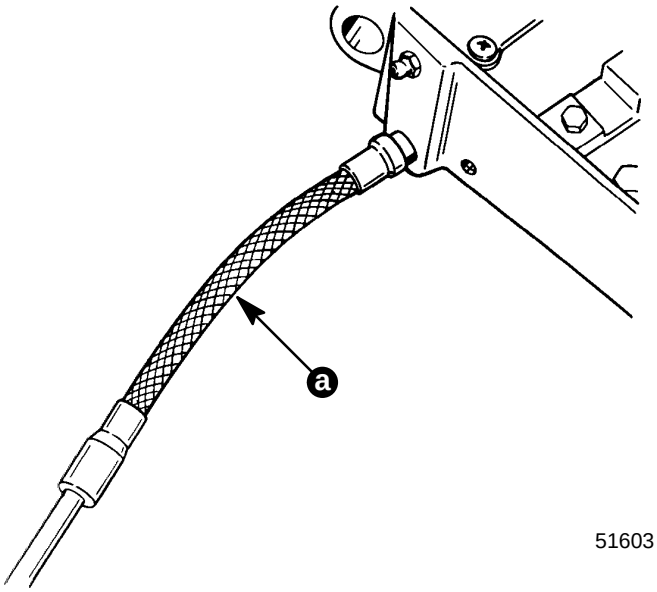
6. Remove allen screw from brass barrel and remove barrel.



51602

a - Allen Screw
b - Brass Barrel

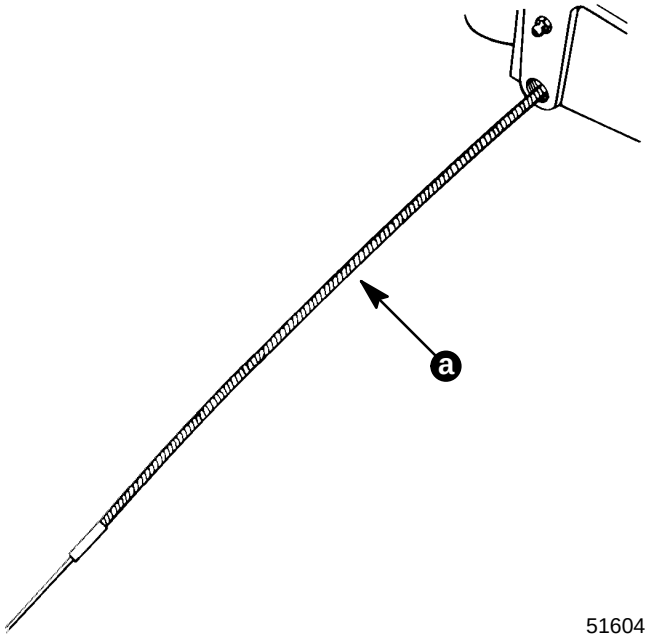
7. Unscrew (counterclockwise) stainless conduit from tiller handle.



51603

a - Conduit

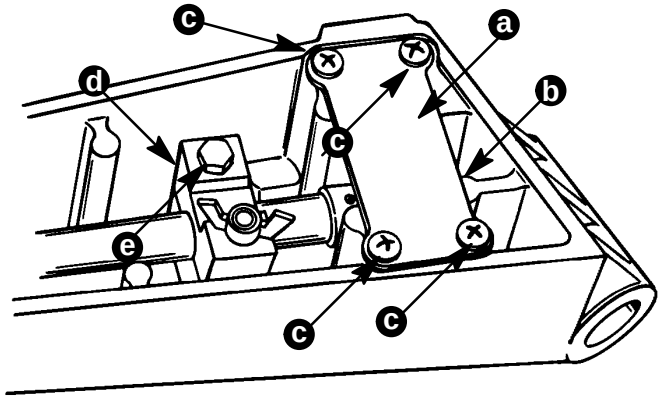
8. Pull throttle cable from tiller handle.



51604

a - Throttle Cable

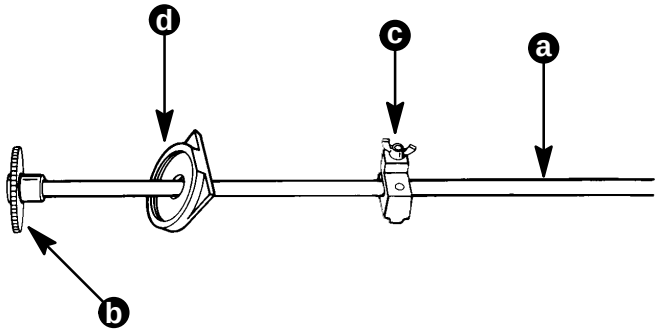
9. Remove cover plate and gasket from tiller handle.
10. Remove bolt from throttle friction assembly.



51604

a - Cover Plate
b - Gasket (below plate)
c - Screws
d - Throttle Friction Assembly
e - Bolt

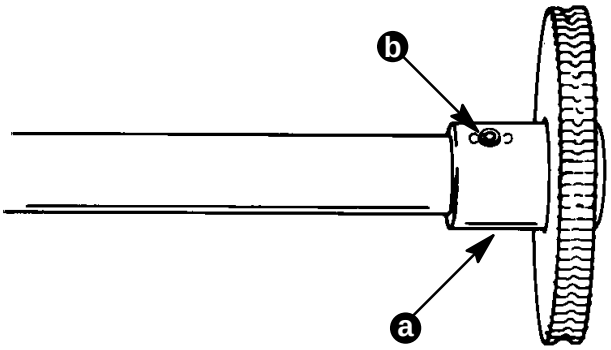
11. Remove throttle arm, gear assembly and friction device from tiller handle. Slide gear cover and friction device off of the throttle arm.



51604

a - Throttle Arm
b - Gear Assembly
c - Friction Device
d - Gear Cover

12. Drive out drift pin and remove throttle gear from throttle arm.

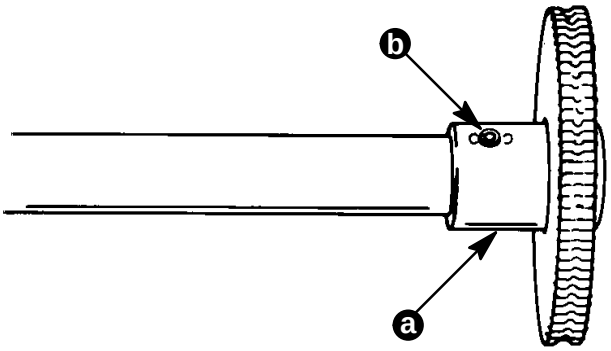


51602

a - Gear
b - Drift Pin

Tiller Arm Reassembly

1. Reinstall throttle gear on throttle arm and secure gear to arm with new drift pin.

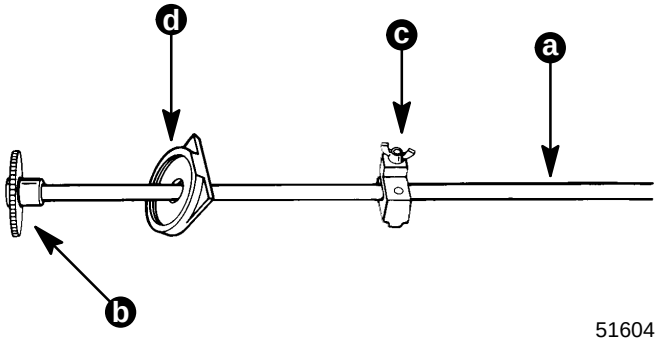


51602

a - Gear
b - Drift Pin

2. Apply a light coat of Special Lubricant 101 to gear teeth and inside of gear cover.

3. Slide cover and friction device onto throttle arm.

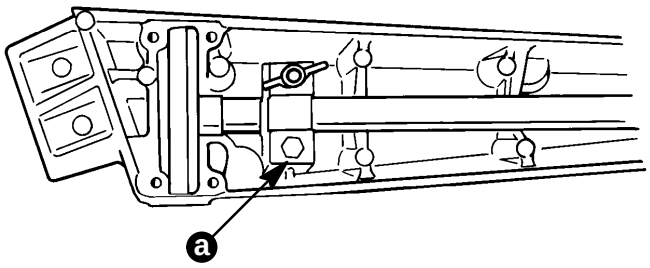


51604

a - Throttle Arm
b - Gear
c - Throttle Friction Device
d - Cover

4. Install throttle arm assembly into tiller arm.

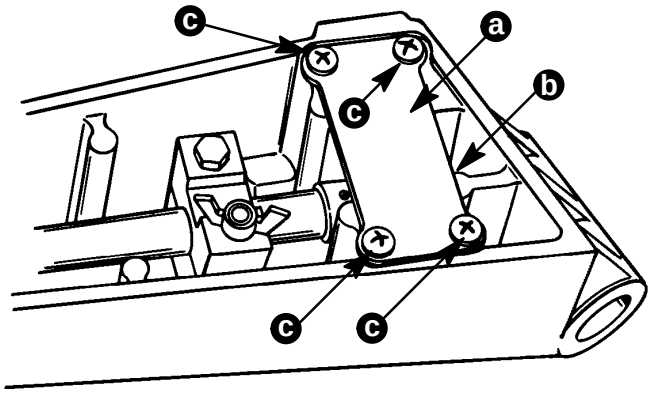
5. Torque friction device attaching bolt to 40 lb. in. (4.5 N·m)



51604

a - Bolt [Torque to 40 lb. in. (4.5 N.m)]

6. Install gasket and cover plate over gear assembly. DO NOT OVERTIGHTEN attaching screws.

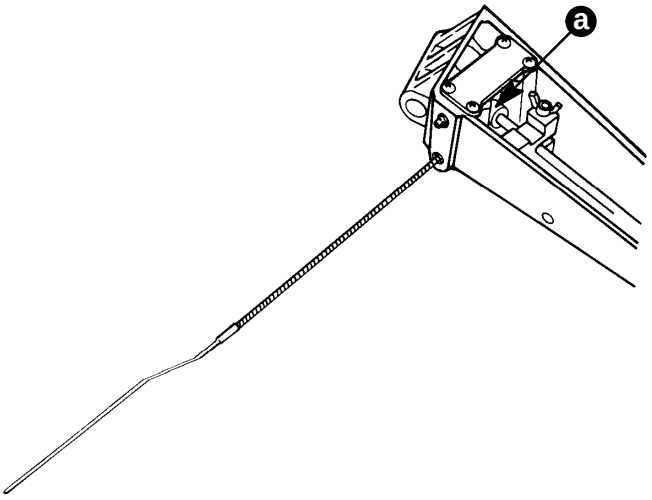


51604

a - Cover Plate
b - Gasket (Below Cover)
c - Screws

7. Rotate throttle arm so that twist grip attaching screw hole faces DOWN and gear drift pin faces UP.

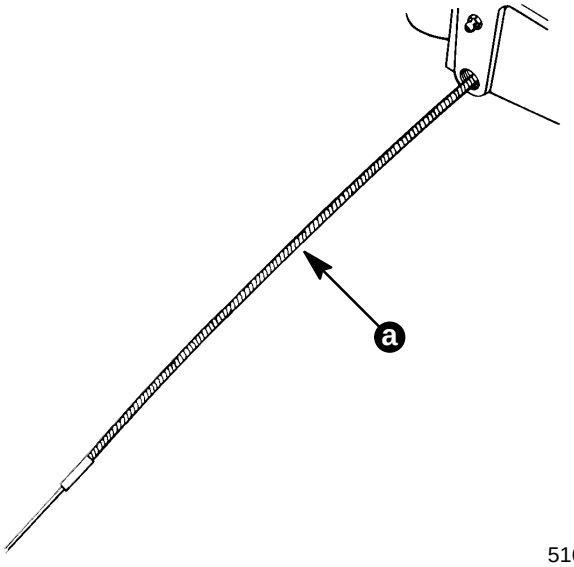
8. Insert throttle cable (CURVED END FACING UP) into tiller handle gear assembly while rotating tiller arm COUNTERCLOCKWISE.



51604

a - Gear Drift Pin (FACES UP)

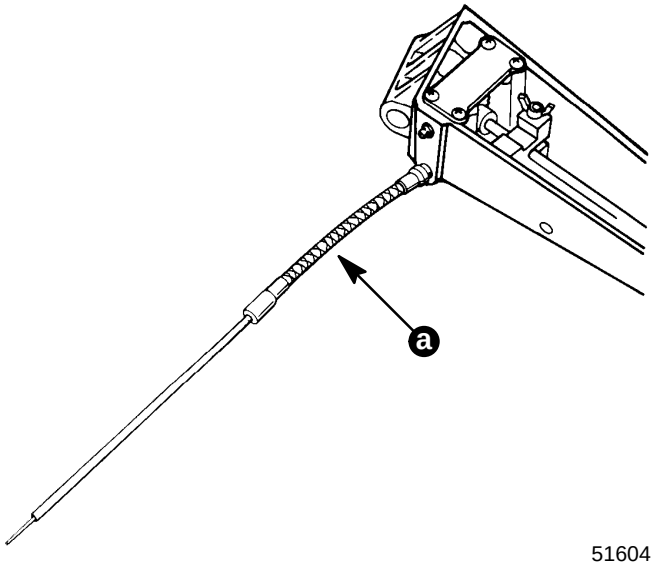
9. Retract throttle cable into gear assembly until approximately 17 in. (43 cm) extends from the tiller arm.



51604

a - Cable [Extends 17 in. (43 cm)]

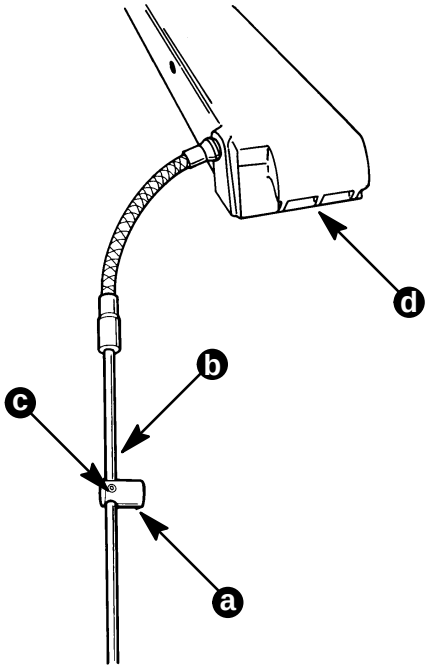
10. Slide stainless steel conduit over throttle cable and thread into tiller arm until lightly seated. Rotate conduit COUNTERCLOCKWISE ONE FULL TURN from a lightly seated position.



51604

a - Stainless Steel Conduit

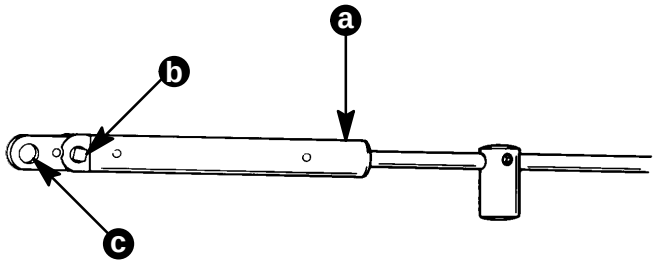
11. Slide brass barrel over throttle cable tube. Secure barrel to tube with allen screw approximately 3.5 in. (89 mm) from stainless conduit. DO NOT OVERTIGHTEN screw as tubing may be crushed binding throttle cable. Position barrel to face towards tiller handle.



51607

a - Brass Barrel
b - Tube
c - Allen Screw
d - Tiller Handle

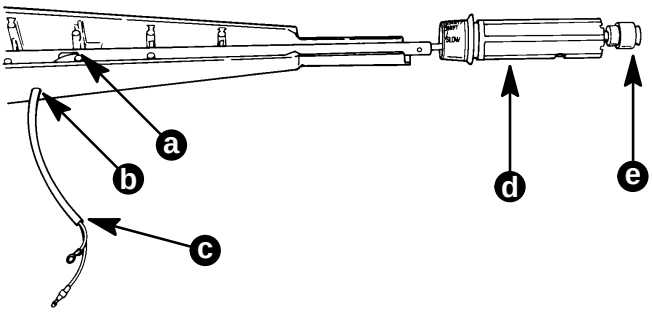
12. Install throttle cable guide onto throttle cable. Secure guide to cable with anchor and two screws. Guide hole should face up.



51602

a - Cable Guide
b - Screws (2)
c - Hole (Faces Up)

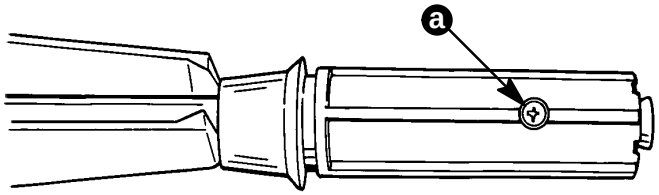
13. Position throttle arm slot to face stop harness exit hole in tiller handle. Route stop switch harness through twist grip, into throttle arm, and out through side of tiller handle.



51602

a - Slot
b - Exit Hole
c - Harness
d - Twist Grip
e - Stop Switch

14. Secure twist grip to throttle arm with attaching screw.



51603

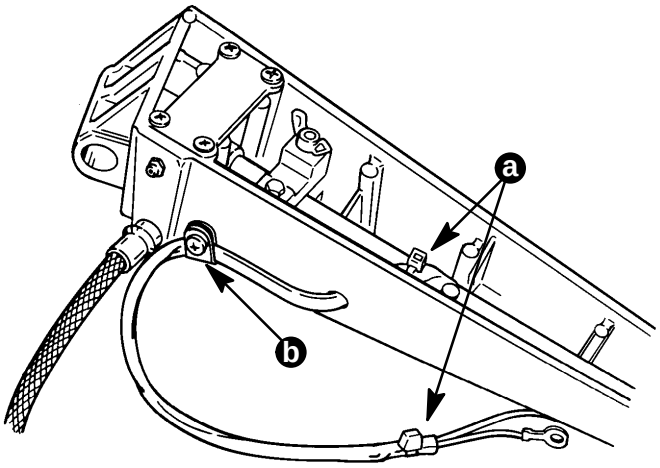
a - Screw

15. Sta-strap harness to throttle arm.

⚠CAUTION

Allow enough slack in harness (rotate throttle grip in both directions) before securing harness to handle assembly with J-clip.

16. Attach harness to tiller arm with J-clip allowing enough slack in harness for full throttle rotation.
17. Attach sta-strap to end of harness sleeve.

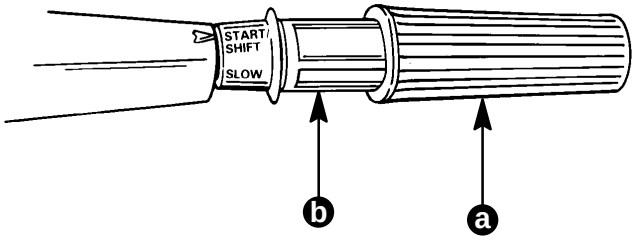


51603

a - Sta-strap
b - J-clip

18. Install rubber twist grip by aligning ridges on plastic twist grip with grooves inside of rubber grip.

NOTE: *Applying a soapy water solution to rubber grip will ease installation.*

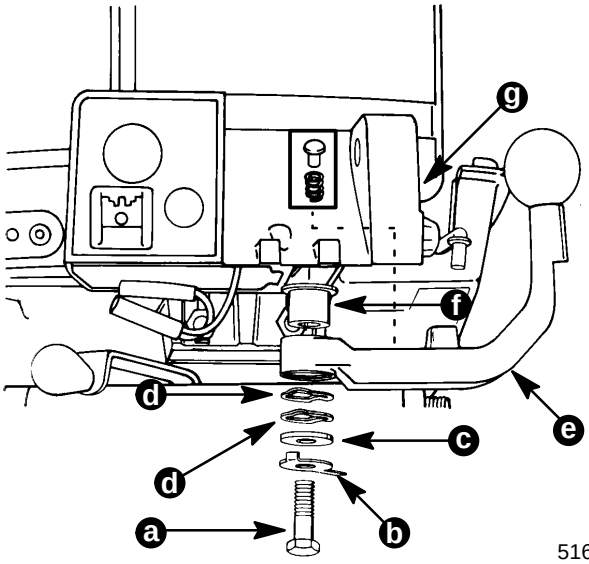


51603

a - Ridges
b - Grooves (Under Handle)

Tiller Arm/Shift Lever Installation

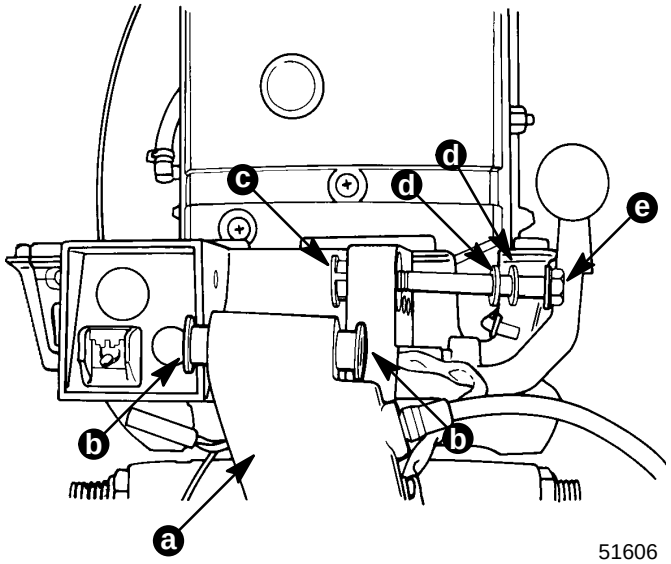
1. Install shift lever with detent assembly to bracket.



51607

a - Bolt
b - Tab Washer
c - Washer
d - Wave Washer (2)
e - Shift Lever
f - Bushing
g - Detent Assembly

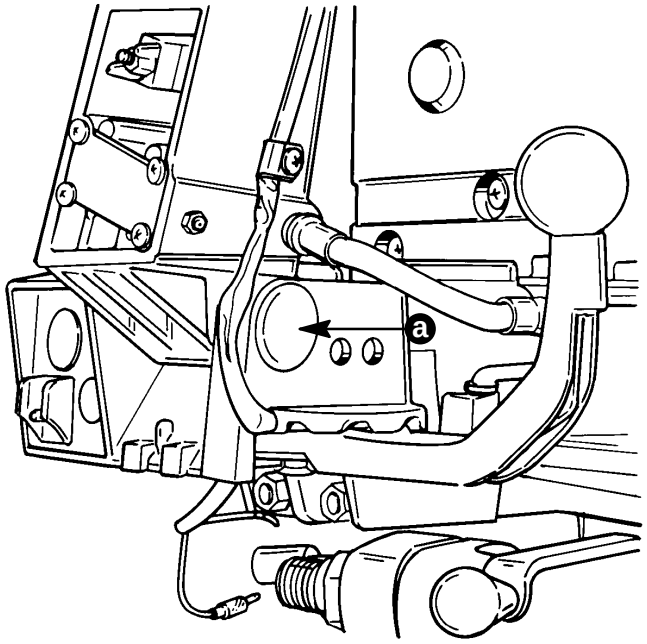
2. Install tiller handle with bushings to bracket. Secure in place with washers and bolt with nut. Tighten bolt allowing tiller handle movement. Torque nut to 40 lb. ft. (54 N·m).



51606

a - Tiller Handle
b - Bushings (2)
c - Stainless Steel Bushing
d - Washers (2)
e - Bolt

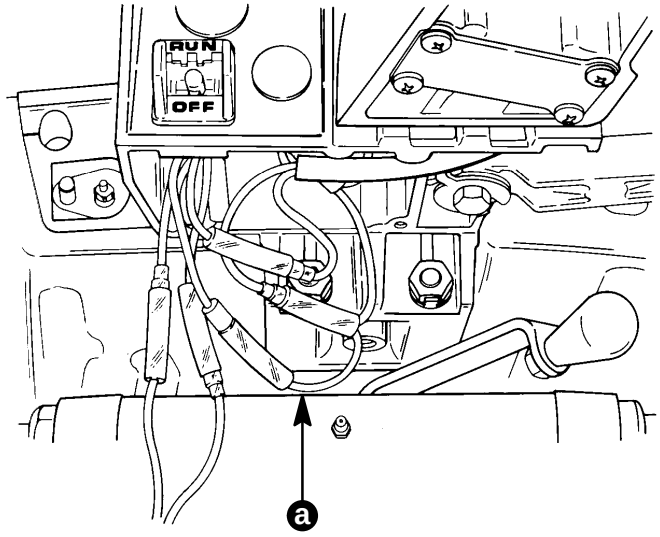
3. Reinstall plug.



51608

a - Plug

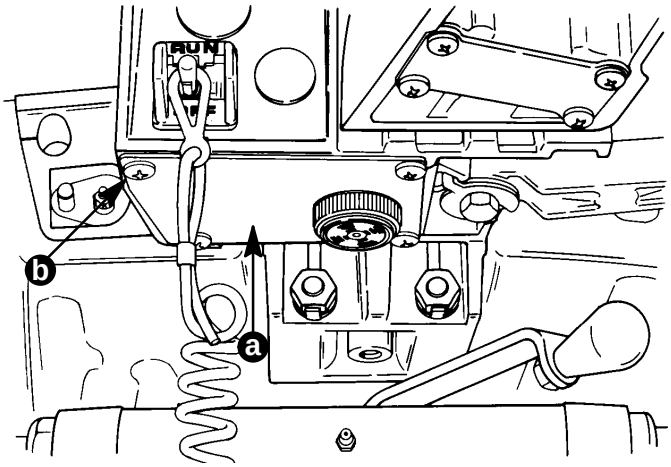
4. Connect stop switch wire at bullet connector and secure ground wire to handle with screw.



51608

a - Stop Switch Wire (Bullet Connector)

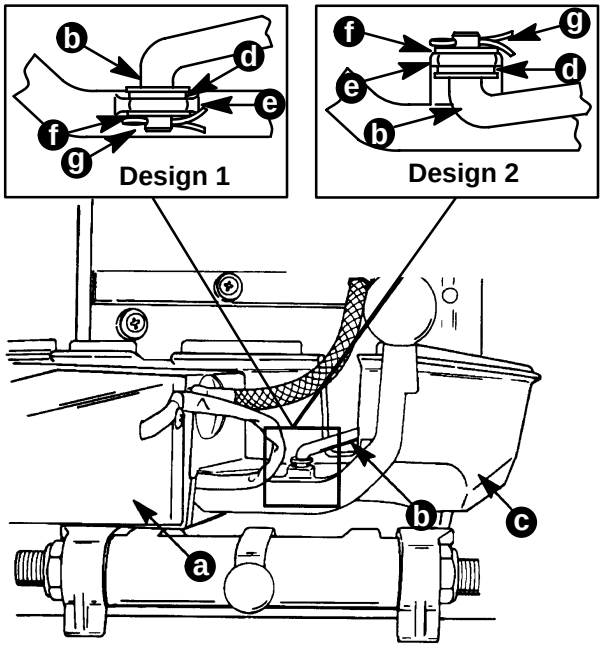
5. Install Cover.



51608

a - Cover
b - Screw (4)

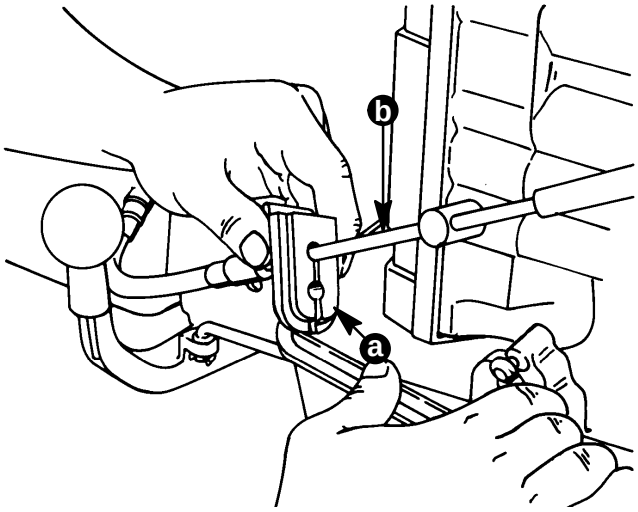
6. Install cotter key and components to shift rod.



54256

a - Tiller Handle
b - Shift Rod
c - Lower Cowl
d - Bushing
e - Shift Handle
f - Washer
g - Cotter Key

7. Install throttle cable with grommet.



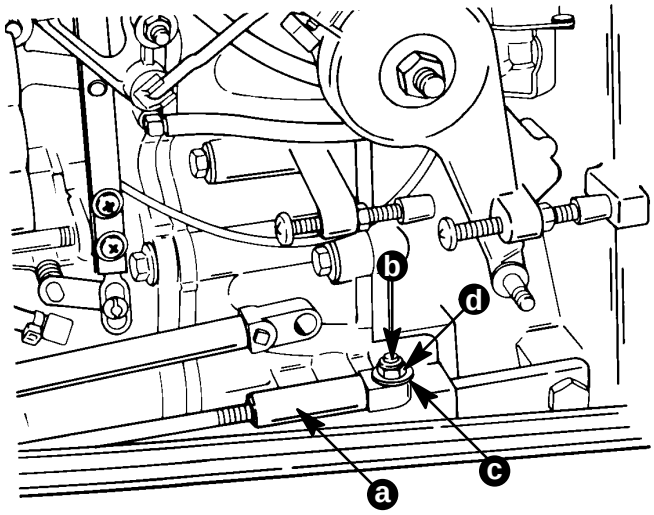
51093

a - Rubber Grommet
b - Throttle Cable

8. Proceed to “Shift Link Rod Installation and Adjustment to Engine” and “Throttle Cable Installation and Adjustment.”

Shift Link Rod Installation and Adjustment to Engine

1. Position shift handle to neutral.
2. Manually shift outboard (shift actuator lever) to neutral. Propeller turns freely in both directions.
3. Adjust shift link rod end to slip over shift actuator bolt with slight preload toward reverse. Install washer and locknut.



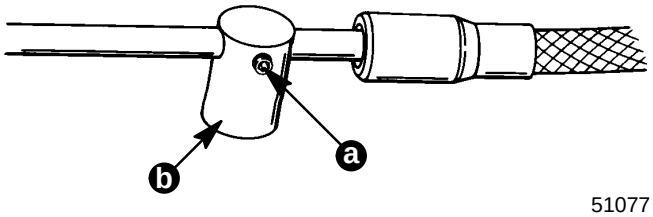
51092

a - Shift Link Rod End
b - Actuator Bolt
c - Washer
d - Locknut (Tighten until snug, then back off 1/4 turn)

4. Check shift link rod adjustment as follows:
   a. Place shift lever in “F” (forward) position. Propeller should rotate in a CLOCKWISE direction. If propeller does not rotate CLOCKWISE, length of link rod must be reduced and step “a” repeated.
   b. Place shift lever in “N” (neutral) position. Propeller should rotate freely without drag. If not, length of link rod must be increased and steps “a” and “b” must be increased.
   c. While rotating propeller, place shift lever in “R” (reverse) position. If propeller can rotate in either direction, length of link rod must be increased and steps “a” thru “c” repeated.
   d. Place engine shift lever in “N” (neutral) position. Propeller should turn freely in both directions. If not, length of link rod must be decreased and steps “a” thru “d” must be repeated.

Throttle Cable Installation and Adjustment

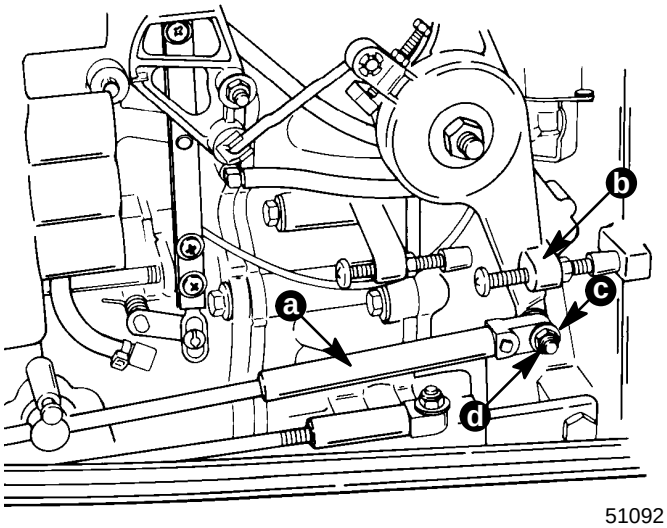
1. Rotate throttle twist grip fully clockwise to stop “IDLE” position.
2. Back out set screw from throttle cable barrel until two or three threads are exposed.



51077

a - Set Screw
b - Throttle Cable Barrel

3. Place end of throttle cable guide over peg of throttle lever and secure with locknut and washer.



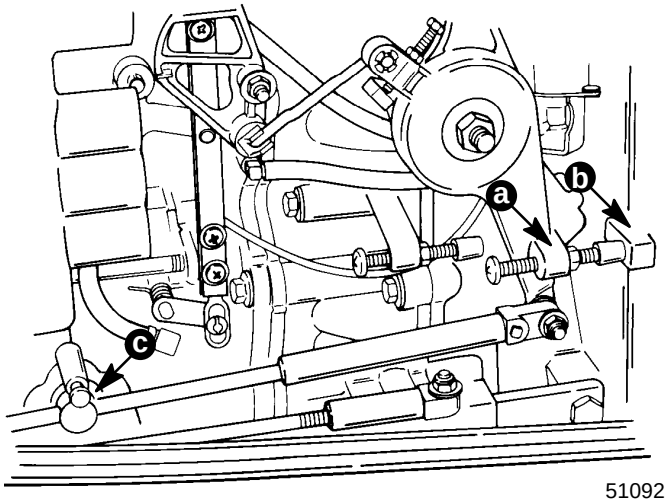
51092

a - Throttle Cable Guide
b - Throttle Lever
c - Washer
d - Locknut (Tighten until snug, then back off 1/4 turn)

⚠ CAUTION

DO NOT exceed 1/4 turn on set screw after it has bottomed-out.

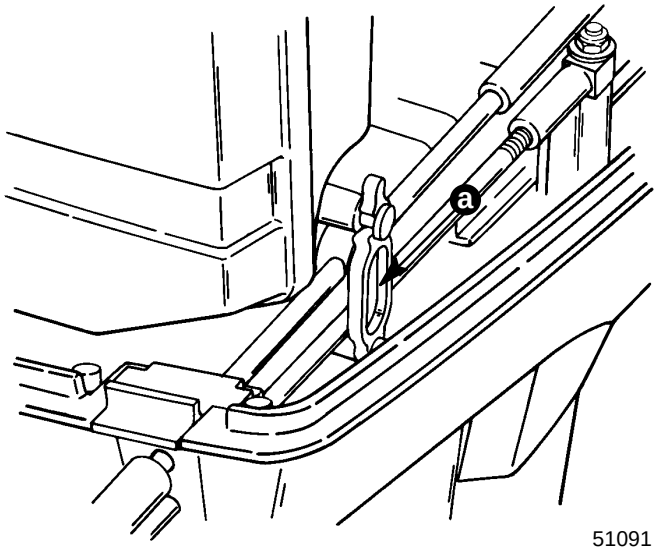
4. Holding throttle lever against idle stop, adjust throttle cable to slip into upper hole of barrel receptacle with a very light preload of throttle lever against idle stop. Apply small amount of Loctite 271 to threads of set screw. Tighten until snug, then an additional 1/8 turn.



51092

a - Throttle Lever
b - Idle Stop
c - Barrel Receptacle

5. Secure barrel in place with barrel retainer.



51091

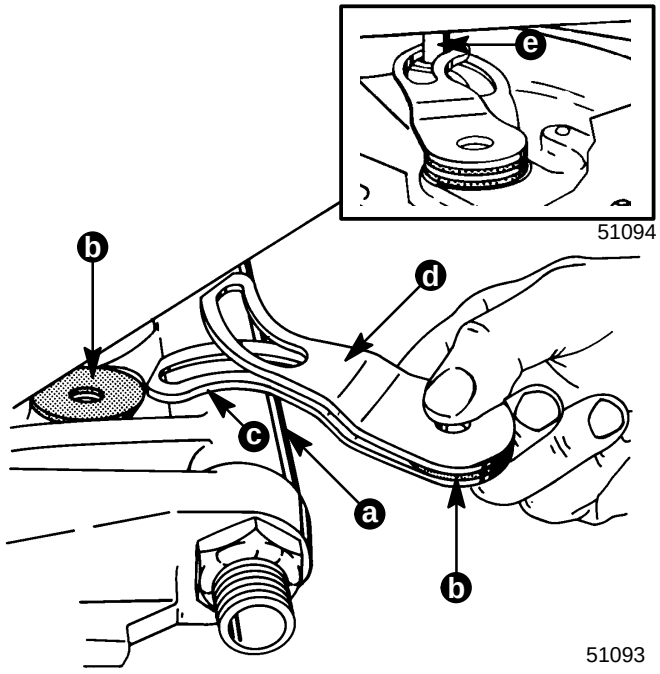
a - Barrel Retainer

6. Check preload on throttle cable by placing a thin piece of paper between idle stop screw and idle stop. Preload is correct when paper can be removed without tearing and still have drag on it. Readjust cable barrel if necessary.
7. Install Cowl.

Co-Pilot Installation

NOTE: *To install Co-Pilot kit, tiller handle must be removed and battery cables disconnected.*

1. Install brake disk on swivel bracket. Position “bottom up” lever, brake disk and “top up” lever onto swivel bracket. Note location of pin (on steering arm) in relation to top and bottom levers as shown.

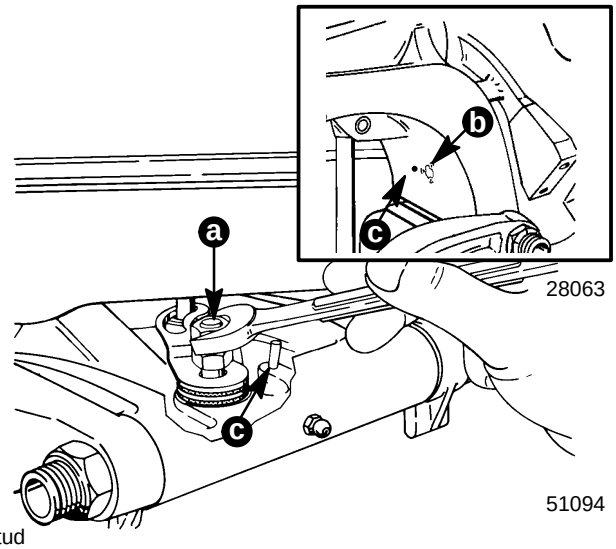


51094

51093

a - Swivel Bracket
b - Brake Disk
c - Bottom Up Lever
d - Top Up Lever
e - Pin, Steering Arm

2. Double nut co-pilot stud and apply Loctite No. 35 (P/N 92-59328-1) to swivel bracket end of stud and install until flush with bottom of swivel bracket. Stake stud in place as shown. Drive dowel pin (c) from bottom of swivel bracket until flush with bottom of bracket.

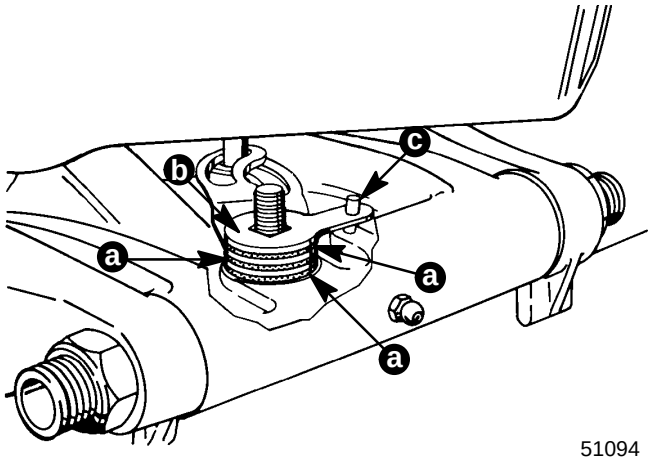


28063

51094

a - Stud
b - Stake Marks
c - Dowel Pin (Driven thru Bottom of Swivel Bracket)

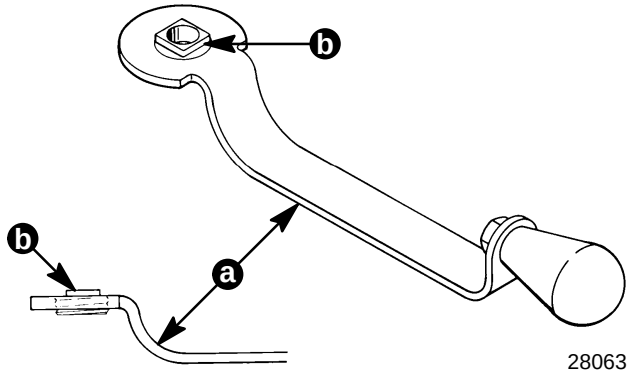
3. Install brake disk and brake.



51094

a - Brake Disk (3)
b - Brake
c - Pin (Holds brake in place)

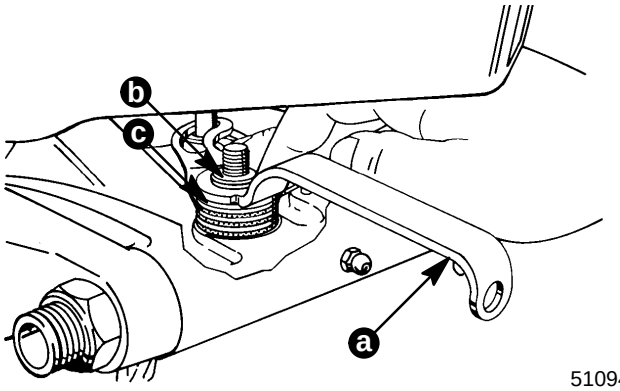
4. Lubricate driver with Never Seize Lubricant or Special Lubricant 101 (P/N 92-13872A1). Install driver into handle and adjust until driver (flat) is flush with handle.



28063

a - Handle
b - Driver (Flush to slightly recessed)

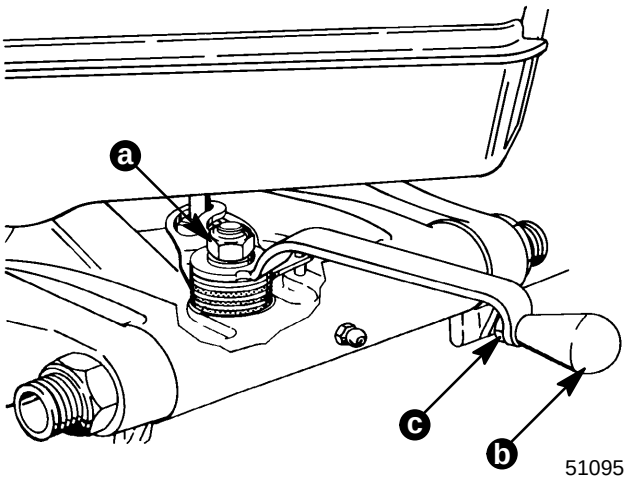
5. Install components to stud. Align hex of driver with hex in brake.



51094

a - Handle
b - Driver
c - Plastic Washer

6. Holding components in place (lever facing forward), install lock nut and torque to 75 lb. in. (8 N·m). Secure knob to lever with bolt.

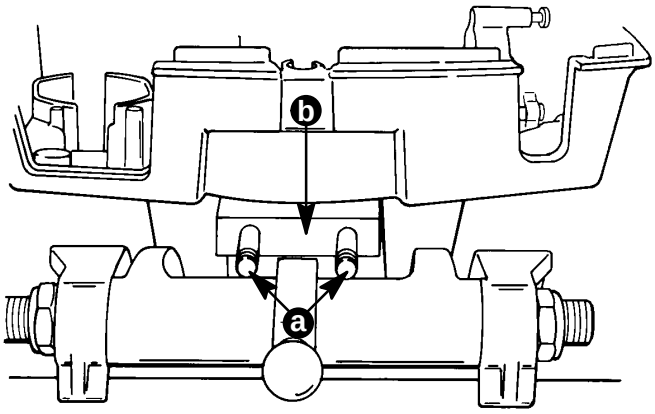


51095

a - Locknut [75 lb. in. (8 N·m)]
b - Knob
c - Bolt [45 lb. in. (5 N·m)]

Tiller Handle Installation

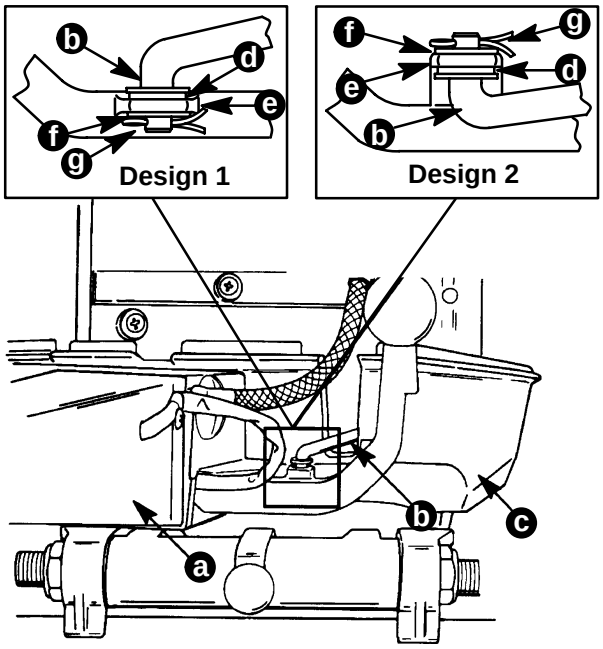
1. Apply Loctite No. 35 (P/N 92-59328-1) to threads (steering arm end) of tiller handle studs. Install with stud installer. Tighten securely.



51092

a - Studs
b - Steering Arm

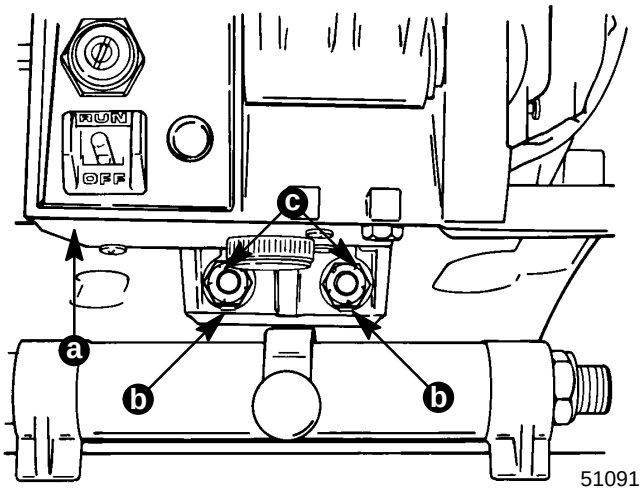
2. Install tiller handle to studs with shift rod positioned thru cowl opening as shown.



54256

a - Tiller Handle
b - Shift Rod
c - Cowl
d - Bushing
e - Shift Handle
f - Washer
g - Cotter Key

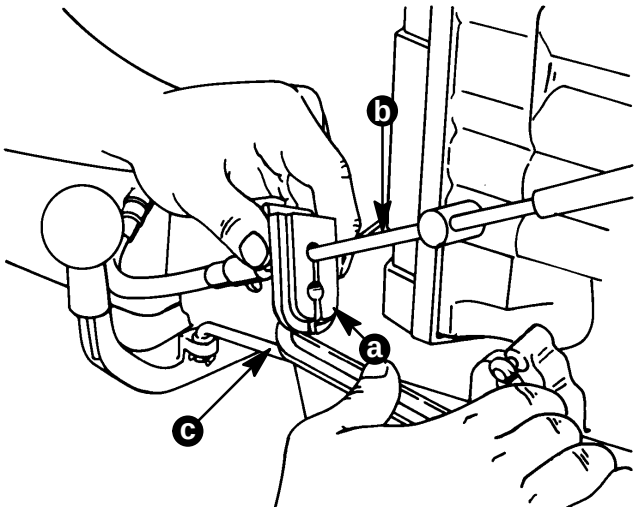
3. Secure tiller handle assembly in place.



51091

a - Tiller Handle Assembly
b - Tab Washer (bend tabs against flats of locknuts)
c - Locknuts [Torque to 26 lb. ft. (35 N·m)]

4. Install rubber grommet to throttle cable and install into bottom cowl. Note, a light lubricant on grommet will aid in installation over shift rod.



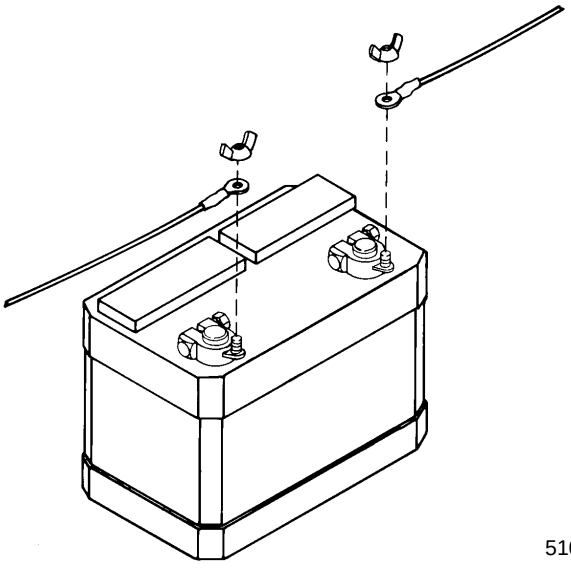
51093

a - Rubber Grommet
b - Throttle Cable
c - Shift Rod

5. Adjust shift link rod and throttle cable “Shift Link Rod Installation and Adjustment” and “Throttle Cable Installation and Adjustment” as required.

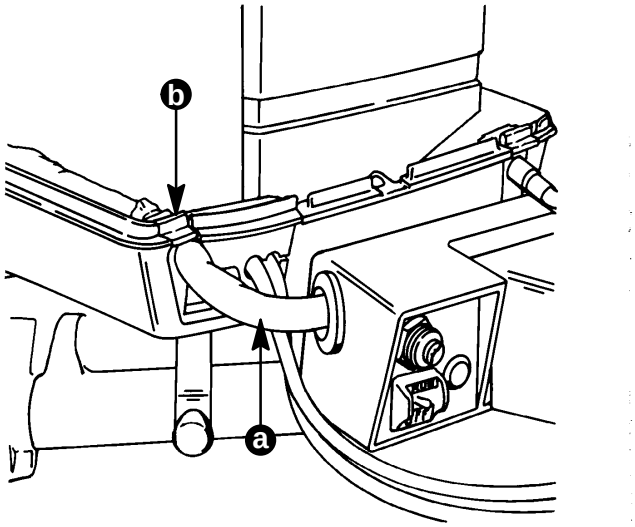
Wiring Harness Connection

1. Remove battery cables from battery.



51084

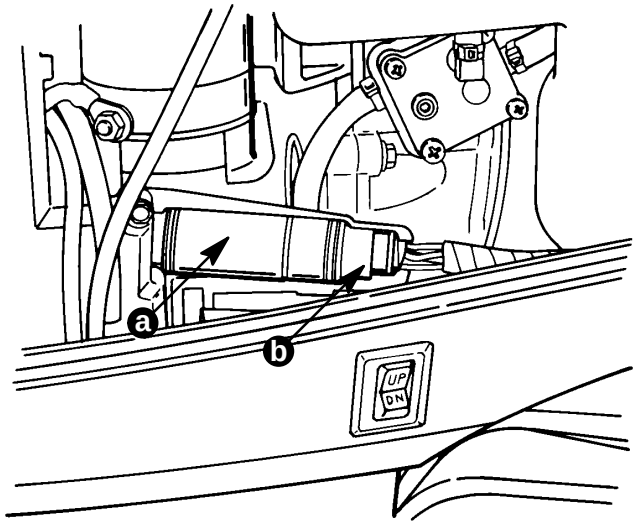
2. Route wiring harness thru rubber grommet. Note, light oil on rubber grommet will aid in wiring harness installation.



51095

a - Wiring Harness
b - Rubber Grommet

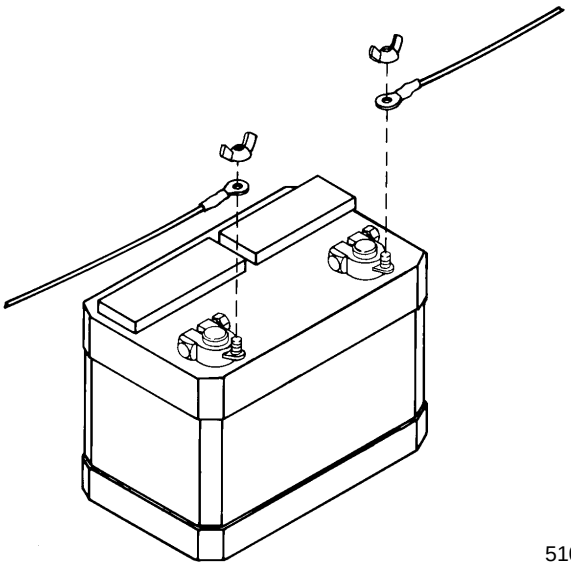
3. Connect handle wiring harness at engine harness connector.



51091

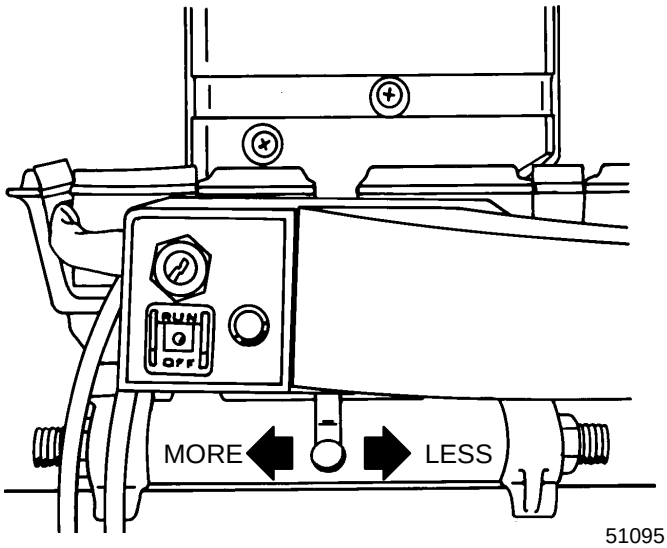
a - Engine Harness Connector
b - Handle Harness Connector

4. Reconnect battery cables.



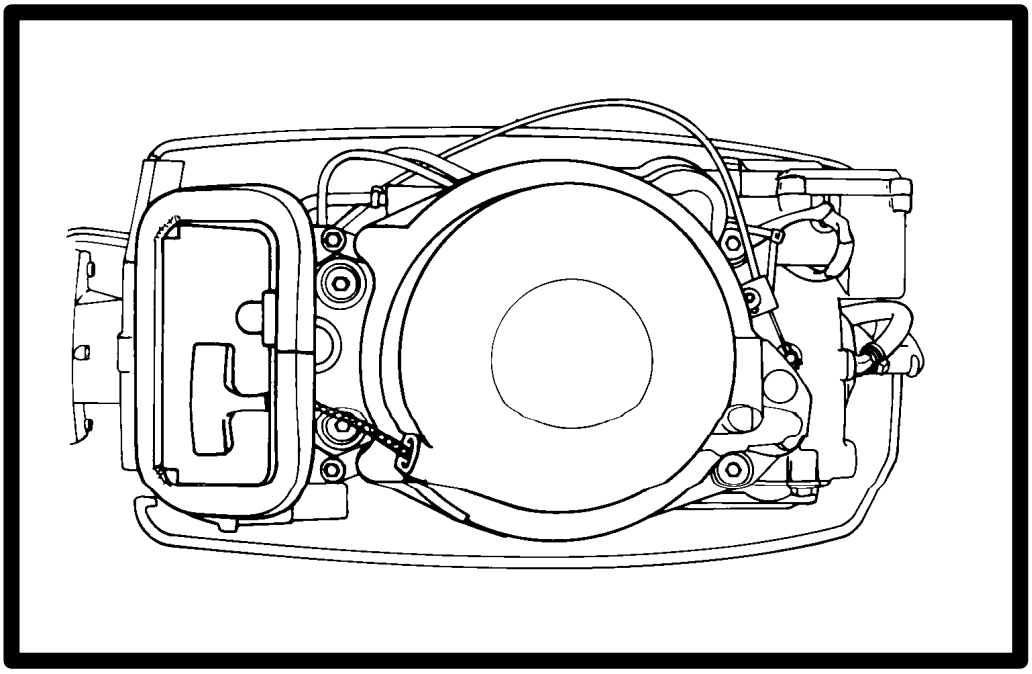
51084

5. Adjust co-pilot tension by moving handle to port (loosen) or starboard (tighten). Locknut on co-pilot stud may have to be adjusted to attain desired tension on tiller arm.



51095

OUTBOARD INSTALLATION/ ATTACHMENTS



REWIND STARTER

7

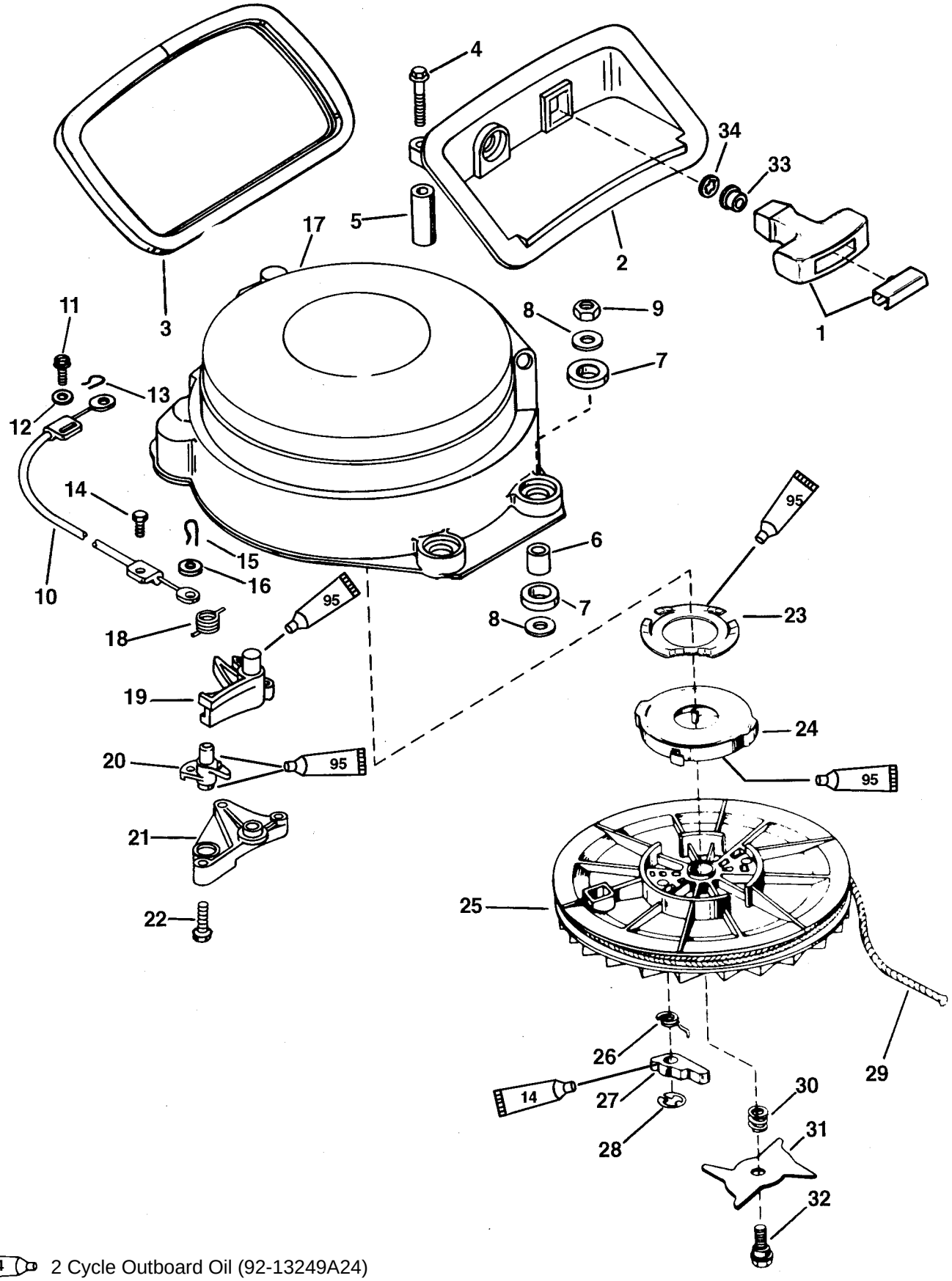
C

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Notes:

Starter Assembly (MANUAL – 55)



14 2 Cycle Outboard Oil (92-13249A24)

95 2-4-C With Teflon (92-825407A12)

Starter Assembly (MANUAL – 55)

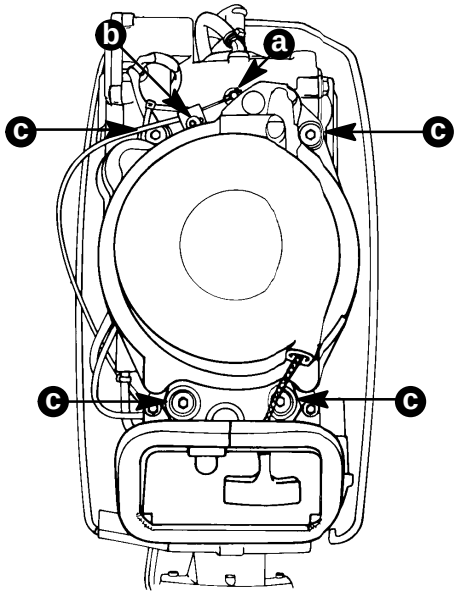
REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	HANDLE ASSEMBLY			
2	1	REST			
3	1	SEAL			
4	2	SCREW	55		6.0
5	2	SPACER			
6	4	BUSHING			
7	8	GROMMET			
8	8	WASHER			
9	4	NUT	75		8.5
10	1	INTERLOCK CABLE			
11	1	SCREW	Drive Tight		
12	1	WASHER			
13	1	COTTER PIN			
14	1	SCREW	Drive Tight		
15	1	COTTER PIN			
16	1	WASHER			
–	1	RECOIL STARTER			
17	1	STARTER HOUSING			
18	1	SPRING			
19	1	INTERLOCK LEVER			
20	1	CAM			
21	1	RETAINER			
22	3	SCREW			
23	1	WASHER - SPRING			
24	1	SPRING			
25	1	STARTER SHEAVE			
26	2	SPRING			
27	2	CAM			
28	2	RETAINING RING			
29	1	STARTER ROPE			
30	1	SPRING			
31	1	CAM			
32	1	SCREW			
33	1	BUSHING			
34	1	RETAINING RING			

Rewind Starter Disassembly

⚠WARNING

When disassembling and reassembling rewind starter, SAFETY GLASSES must be worn in case rewind spring uncoils out of the housing.

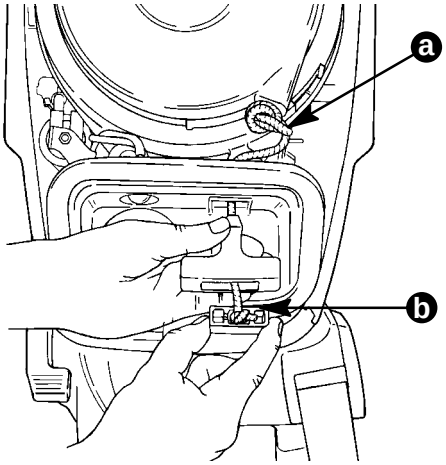
1. Remove retaining clip and attaching screw which secures shift interlock cable to starter housing.
2. Remove bolts (4) securing rewind starter to engine.



51606

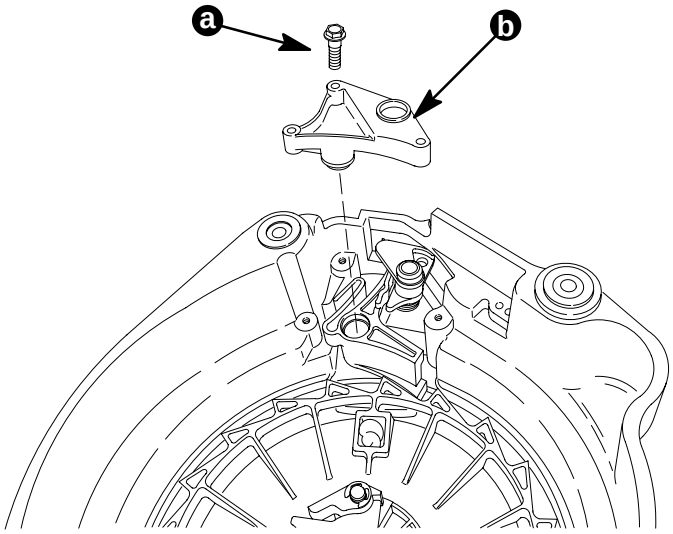
a - Retaining Clip
b - Screw
c - Bolts (4)

3. Slowly pull the starter rope out from the handle rest approximately 2 feet (60 cm) and tie an overhand knot between the rewind housing and the handle rest.
4. Remove retainer from rope handle and untie the rope handle knot.
5. Remove the rewind starter.



a - Overhand Knot
b - Retainer

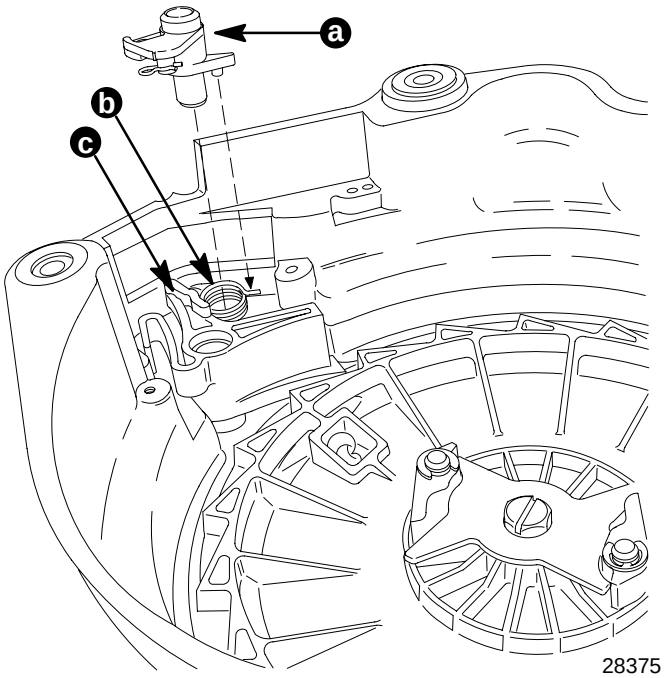
6. Remove cam retainer.



28374

a - Screws (3)
b - Cam Retainer

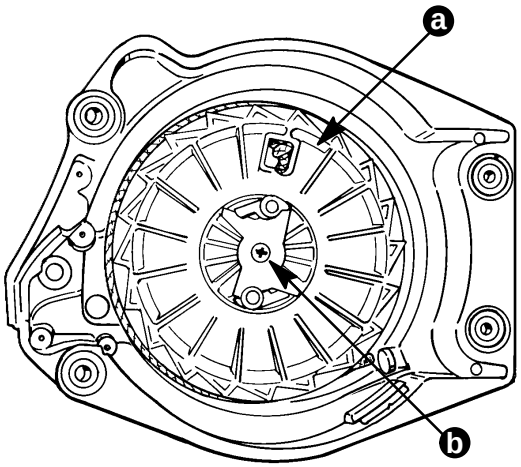
7. Remove cam lever, cam lever spring, and interlock lever.



28375

a - Cam Lever
b - Cam Lever Spring
c - Interlock Lever

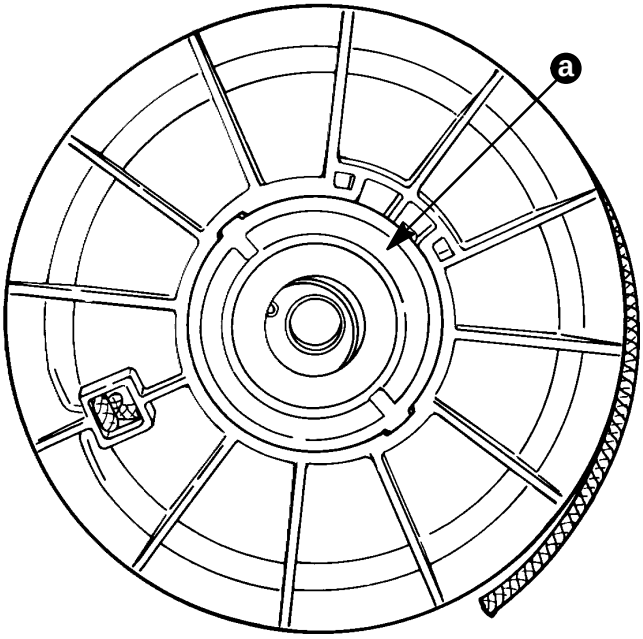
8. Remove starter sheave.



51605

a - Starter Sheave
b - Screw

9. Spring is replaced as a spring/cover assembly.



51607

a - Spring/Cover Assembly

Cleaning and Inspection

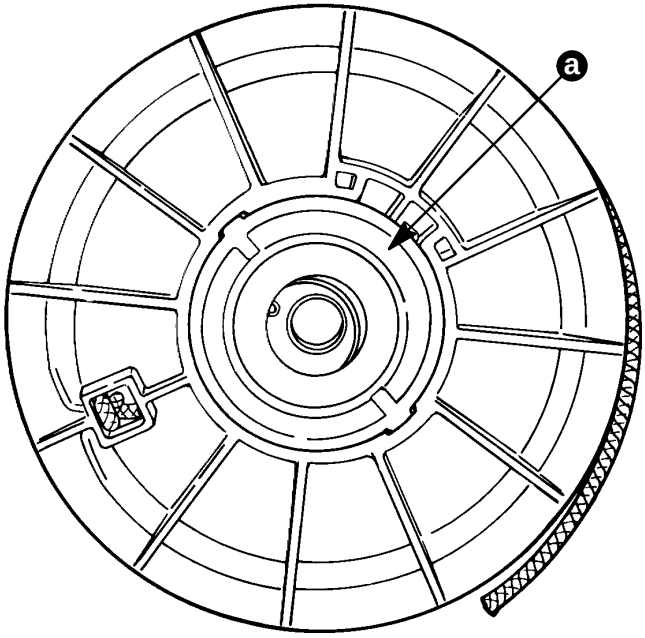
1. Clean components in solvent and dry with compressed air.
2. Inspect rewind spring for kinks, burrs, corrosion of breakage.
3. Inspect starter sheave, rope guide and starter housing for nicks, grooves, cracks, wear or distortion, especially area of rope travel.
4. Inspect bushing, starter drive pawl and spring for wear or damage.
5. Inspect starter rope for wear.
6. Replace components as necessary.

Rewind Starter Reassembly

⚠ WARNING

When reassembling rewind starter, SAFETY GLASSES must be worn in case rewind spring uncoils out of the housing.

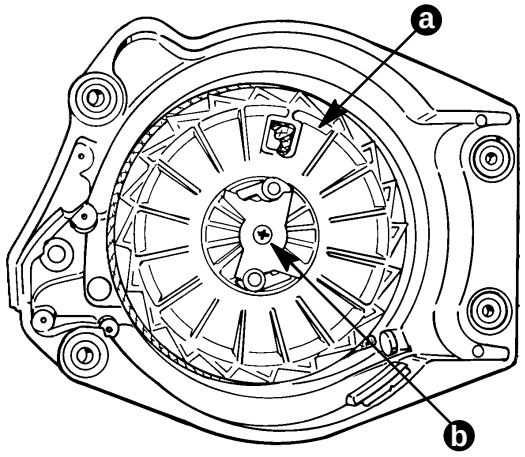
1. Install spring/cover assembly into sheave.



51607

a - Spring/Cover Assembly

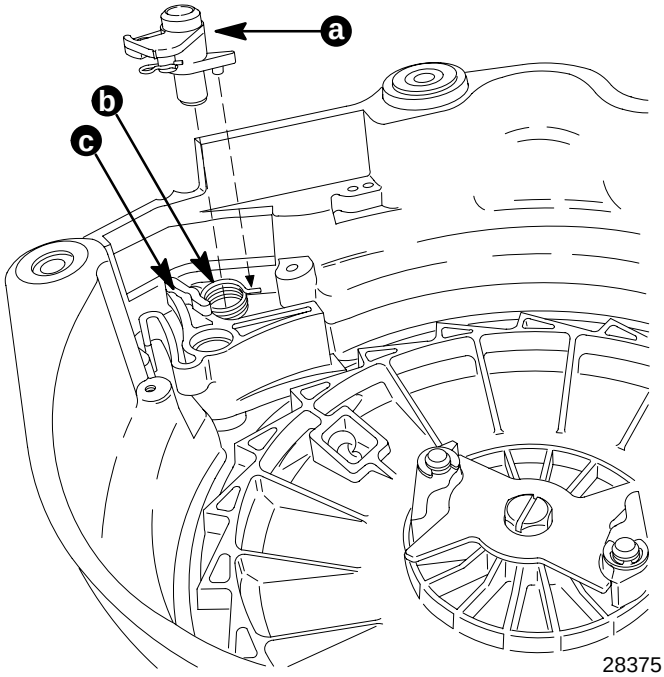
2. Install starter sheave to housing and secure in place with screw. Torque to 135 lb. in. (15.3 N·m).



51605

a - Starter Sheave
b - Screw

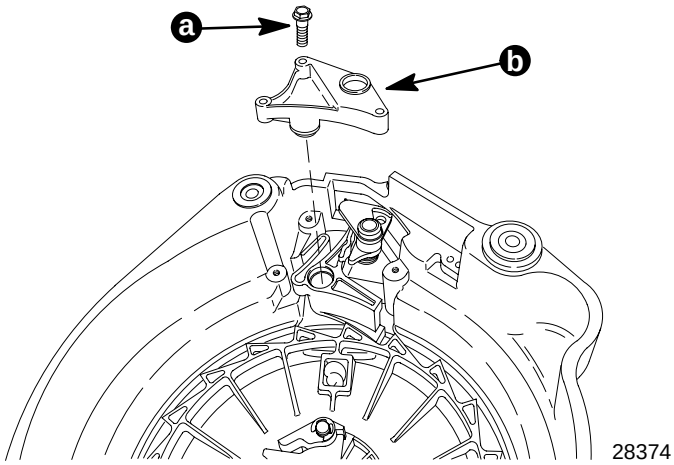
3. Install interlock lever, position cam spring into recess of starter housing and reinstall cam lever.



28375

a - Cam Lever
b - Cam Lever Spring
c - Interlock Lever

4. Reinstall cam retainer and secure with screws (3).

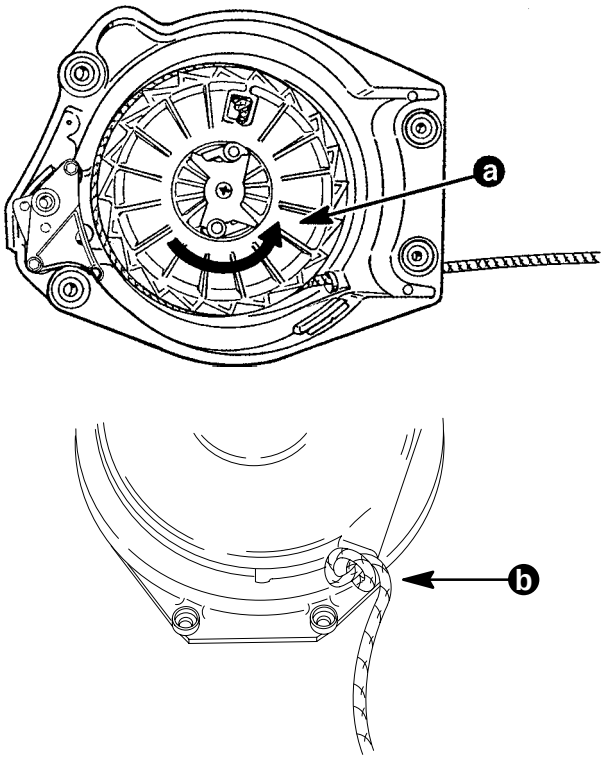


28374

a - Screws (3)
b - Cam Retainer

Adjusting Rewind Spring Tension

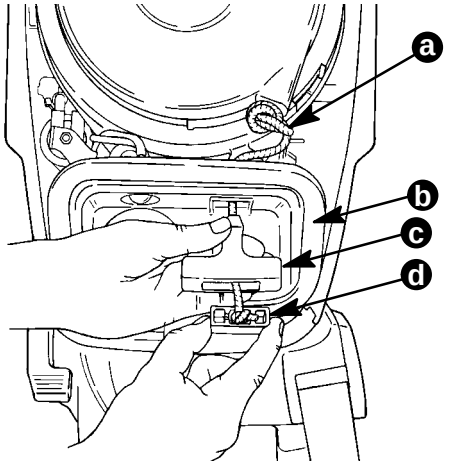
1. Rotate sheave counterclockwise until it stops (coil is bound). Then back off one full turn, plus what is needed to align rope end with hole in housing. Never back off sheave less than one full turn.
2. Route starter rope thru rope guide in housing. Tie a overhand knot in rope approximately 12 in. (305 mm) from end of rope.



a - Rotate Counterclockwise and Back Off at Laest One Full Turn
b - Tie Off Starter Rope 12 Inches (305 mm) from End with Overhand Knot

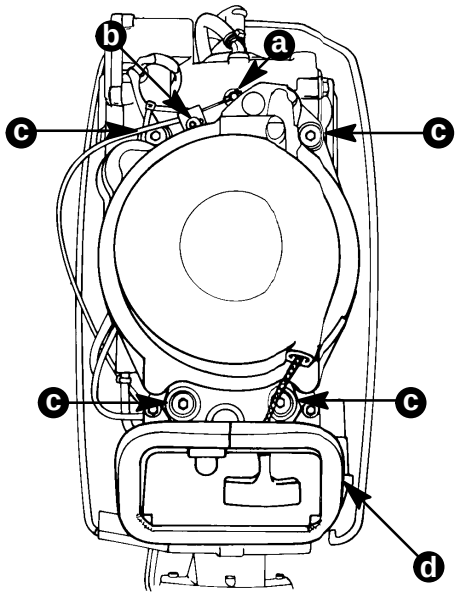
NOTE: *Check operation of rewind and rewind tension before outboard installation.*

3. Place rewind starter on engine.
4. Pull starter rope thru bracket, handle, and starter rope retainer. Secure starter rope to starter rope retainer with knot.



a - Starter Rope
b - Bracket
c - Handle
d - Starter Rope Retainer

5. Secure rewind starter to engine bolts (4), torque to 90 lb. in. (10 N·m). Secure interlock lock cable with retaining clip and screw.



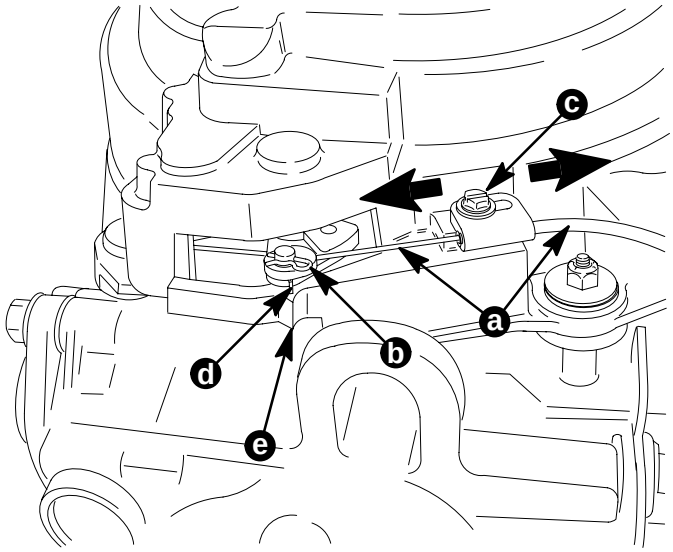
51606

a - Retaining Clip
b - Screw
c - Bolts (4) Torque to 90 lb. in. (10 N·m)
d - Bracket

Starter Interlock Cable Adjustment

IMPORTANT: Lubricate core wire of interlock cable with light oil prior to making adjustments.

1. While rotating the propeller shaft, place the gear shift lever into REVERSE.
2. Return the gear shift lever to NEUTRAL without going past neutral detent.
3. Place end of interlock cable over pin of cam lever and secure with retaining pin.
4. Secure interlock cable to starter housing using adjusting screw. Do not tighted screw at this time.
5. Adjust interlock cable to align raised mark of cam lever with pointer of rewind housing.



28376

a - Interlock Cable
b - Retaining Pin
c - Adjustment Screw
d - Raised Mark of Cam Lever
e - Pointer of Rewind Housing

6. Tighten cable adjustment screw and check adjustment after 4 or 5 shift cycles.